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# NOTES

Taken from Lectures

-of-

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# OPERATIVE DENTISTRY.

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TEETH. Teeth are small dense hard organs, composed of osseous tissue and inserted into the maxilla at the entrance of the alimentary canal.

Teeth are properly speaking dermal organs and as such partake of the nature of the skin; persons having a light delicate skin usually possess teeth of a light delicate character and vice-versa.

## DEVELOPMENT OF TEETH.

The development of teeth begins at a very early stage of intra-interine life. The first sign is a slight longitudinal depression along the maxillary ridge the depth of which is increased by a thickening of the epithelial cells on either side. The cells of the lower layer of epithelium under the depression proliferate downwards and expand outwards into a Florence flask shape, being quite narrow above where the upper layer of epithelium remains unaffected. This flask like space is filled with cells many of them being stellate. From the base of this flask shaped space a papilla grows upwards which afterwards becomes the dentine and pulp (the dentine being formed at expense of the pulp) of the tooth. Upon the outside of the enamel organ a new tissue is now formed in such a manner as to sacculate it. This downward grows into the tissue in the form of a double membrane the outer layer of which subsequently forms the periostuim the inner becoming ossified to form the cementum. By the gradual development of the root and cementum the tooth is forced upward and erupted.

uterine

eek of foetus

## CALCIFICATION.

Calcification in dentine is endogenous, that is from without inwards, beginning at the cusps and extending inward and downwards. In the enamel it is exogenous that is from within outwards, beginning at a point corresponding to that where the dentine commences and extending outwards.

A tooth is made up of 4 tissues:--

1. Enamel.
2. Dentine.
3. Cementum and
4. Pulp

to which may be added 3 membranes

a. Nasmyths
b. Interosseous and
c. Periostium.

NASMYTHS MEMBRANE covers the enamel and gives it its polish. When lost, fluids can more easily penetrate the enamel and cause caries.

THE INTEROSSEOUS MEMBRANE is between the enamel and dentine being the remains of the layer of epithelium which was pushed up by the papilla in the formation of the dentine and enamel together.

THE PERIOSTIUM covers the root and does not differ from ordinary periostium.

THE ENAMEL being the least vital of the tooth structures is nourished through the interosseous membrane by the dentine. The dentine receives its nutriment from the cementum and the cementum is connected with the rest of the system by the periostium.

The function of the pulp is to develop the dentine and to furnish nutrition and sensation.

Enamel is the hardest animal tissue known. It is made up of hexagonal rods about the 1/5500 of an inch in diameter. These rods are not homogeneous but are made up of a number of sections standing on each other. These ends of these sections are cop-shaped on one end and convex on the other end, and the rods are not straight but wavy. Good enamel contains 3% organic and 97% inorganic matter. Fair enamel 5% and 95%.

ENAMEL CALCIFIES that is it hardens from material contained in the enamel organ no new material being carried to it. Enamel is porous shown by drying when covered by "dam".

DENTINE OSSIFIES the calcareous materials being carried to the periphery of the pulp and deposited. The active agents in this process are the odontoblasts which constitute the outer layer of the pulp. In these odontoblasts the calcareous matter is deposited the nucleus being excepted. As one layer of odontoblasts becomes ossified another takes its place so that the dentine is formed in lamellae or concentric rings, the pulp becoming smaller and smaller. The nuclei of the cells remain and as they are connected by processes they constitute the dental tubuli. Between the tubuli are somewhat irregular spaces known as intertubular spaces. They are filled with lime salts. The lime salts in those intertubular spaces are said to be inorganized while those in the walls of the tubuli are said to be organized.

DENTINE is a hard osseous tissue in which calcareous material is arranged concentrically around the pulp, penetrating which layers are a great number of tubules which branch and anastomose with each other. Good dentine contains 25% organic and 75% inorganic matter. Dentine constitutes the tooth proper the other structures being appendices, the enamel for protection the cementum for nutrition.

The dentinal tubules are occupied by prolongations of the odontoblasts which line the pulp chamber. Sensation in the dentine is due to the contents of these tubules. Although they do not contain nerve fibrils still being protoplasmic they are susceptible to irritation at their peripheral extremities and can convey impressions to the nerve fibrils which lie next to the odontoblasts. Dentinal tubules are about 1/4500 of an inch in diameter. It is very likely that dentine is not vascular and hence is not subject to inflammation. Very exceptional cases are found where teeth evidently are vascular.

CEMENTUM. Cementum is less vascular and less highly vitalized than bone being somewhat more dense. It contains lacunae and canaculi but no Haversian canals. It is nourished from the periostium through the canalculi and lacunae. The canalculi of the cementum and the tubules of the dentine appear to anastomose at their extremity and through them the dentine is nourished after the death of the pulp.

Cementum contains about 70% inorganic and 30% organic matter.

FUNCTIONS. To afford a bond of union between the dense dentine and the loss of the bone.

PULP. The pulp occupies the central part of the tooth and in form it approximates that of the tooth. In young patients the pulp is comparatively larger than in older patients. In molars for instance during youth the pulp has "horns" corresponding to the cusps of the teeth.

In health the pulp is a light reddish gray pulpy mass composed chiefly of fluid. In addition to the fluid it has bloodvessels, nerve filaments and connective tissue. In the pulp chamber capillaries are the only variety of vessels found but in the canals are found arteries and veins. Upon the outer surface of the pulp is a layer of cells called odontoblasts closely aggregated together and having processes projecting the tubules. They constitute the lining membrane of the pulp chamber.

Immediately beneath this layer is a second layer partially developed into odontoblasts, and if the true odontoblasts become converted into dentine these take their places. This process of new formation of dentine is the result of irritation from caries, a filling &c.

The pulp is an exceedingly vascular tissue and as such is very susceptible to inflammation. If the pulp or any part of it is once the seat of acute inflammation it never returns to its normal condition. The apical opening is very minute as there is a constriction in the canal near the extremity of the root. Through this minute opening pass an artery, a vein and a nerve. If from any cause there is an increased determination of blood to the part the artery enlarges and presses upon the nerve causing pain, which may last until the nerve becomes paralyxed when it ceases. By pressing upon the vein it prevents the egress of blood causing stasis and death.

FUNCTIONS. (1) Chiefly to build up the tooth.
(2) To nourish the tooth.
(3) To furnish sensation and thus prevent neglect.

PERIOSTUM. This probably consists of two membranes one lining the socket the other covering the root. They cannot be entirely separated however.

ITS FUNCTIONS ARE:-

I. It is the nutrient membrane of the cementum.
II.. It attaches the root firmly to the socket.
III. It forms a cushion which breaks the force of the impact in mastication.

It is composed of white fibrous connective tissue forming a dense tough vascular membrane. It is continuous with the mucous lining of the mouth and is susceptible to inflammation on account of thet continuity. For Ex- in Salivation.

GUMS. Composed of muco-periosteal tissue which is vascular but poorly supplied with nerves.

FUNCTIONS OF TEETH.

1. They are the passive organs of mastication.
2. They assist in distinct articulation.
3. They assist in giving expression to the face.

For these purposes they are admirably adapted On account of the cushion formed by the periostium they are unaffected by the concussion of mastication. Also on account of the enamel and dentine varying in density and being both non-conductors, the tooth is not affected by thermal changes when in a normal state.

## DEFECTS OF DEVELOPMENT WHICH PREDISPOSE TO PATHOLOGICAL CONDITIONS.

### ENAMEL.

1. Where the enamel rods fail to calcify throughout their entire length leaving tubes which penetrate the rod from the periphery. Those then somewhat resemble dentine tubules.- Rare.
2. Where one or more rods fail to calcify leaving an opening from the surface of the tooth to the dentine. This is also rare but is occasionally seen in the extreme cusp of a cuspid or a bicuspid.
3. Where the enamel rods are loosely aggregated so that when the enamel is cut it breaks up into rough edges.
4. Where the entire enamel tissue appeared to be granular. This is a very serious defect.
5. Where there is a lack of coalessence of the islands of calcification.
6. Where the surface of the enamel is roughened presenting pits and grooves,- Rocky enamel.
7. Syphilitic tooth presenting notch on cutting edge or crescentic grove on the surface.

The fifth class is perhaps the most common and most serious. In a molar, for instance, with four cusps, there will be four centres or islands of calcification. From these centres the process of calcification extends until the islands meet at the sides where the process may stop, leaving the central space uncalcified.

Molars having a ridge running diagonally across the grinding surface have two weak spots.

From these centres of calcification the process extends downwards to the neck of the tooth. Where these join at the sides of the teeth are lines of weakness and caries usually begins at a point near the centre of these lines. Molars have these lines in their 4 surfaces- Buccal, Lingual, Mosial and Distal. Bicuspids have them only on their approximal surfaces. The same is true of incisors while cuspids have no weak point from that cause as the process of calcification begins at the cusp and "flows down" over the tooth towards the neck.

ROCKY ENAMEL is probably due to an interruption of the nutritive process at the time of calcification, by an eruptive disease such as measles or scarlet fever. It is found on the six anterior teeth and the 1st molars, as the 1st molars are developed about the same time as the incisors. This defect does not necessarily imply a predisposition to caries.

The notch or groove of syphilitic teeth is most apt to be observed in the superior central incisors while the other teeth particularly the laterals have a tendency to be pegshaped.

## DEFECTS IN THE DEVELOPMENT OF DENTINE.

These are not so serious as those in the enamel and if the enamel is perfect it matters little about the dentine. While the defective development of enamel is permanent that of the dentine is not necessarily so, as the process of depositing bone may be resumed at any time. While the pulp remains alive the dentine may improve or deteriorate.

1. Defective development of the walls of the dentine tubules is somewhat similar to what causes rocky enamel in the enamel.
2. Abnormal size and number of the interglobular spaces which lie just beneath the interosseous membrane. The presence of interglobular spaces is probable due to one or more of the odontoblasts being absent.

In order that children may have well-developed teeth a demand for them must be created by giving them food which requires rigorous use of the organs of mastication. This causes a determination of blood to the part and strengthens the jaws as well as the teeth. Any such treatment with a view to improving the teeth must be made use of before the child is five years of age.

## ERUPTION OF TEMPORARY TEETH.

| | | |
|---|---|---|
| Lower central Incisors about | 6th | Month |
| Upper " " " | 8th | " |
| Upper and Lower Laterals " | 7 - 9 | " |
| Cuspids and 1st Molars before | 10 - 14 | " |
| 2nd Molars | 24th | " |

These figures are only general but the temporary dentition is usually completed when the child has reached two years of age.

As a rule the temporary teeth should be retained until the permanent teeth are ready to replace them.

Too early extraction may be injurious for three reasons:-

1. The germ of the permanent tooth may be extracted along with the temporary.
2. After the temporary tooth is gone the permanent may be erupted years before its time and consequently be imperfectly developed and predisposed to caries.
3. If the succeeding tooth does not erupt the jaw may fail to expand or it even may contract causing a crowded condition.

There are several reasons why temporary teeth should be treated and filled:-

1. To relieve pain.
2. If the teeth are tender and painful the food is not

properly masticated causing digestive derangements.

3. The teeth being painful and not much used there is no demand for solid structure and no marked determination of tooth producing substance to the part so that the permanent teeth are of poor structure.

It is seldom desirable to extract temporary teeth for purposes of regulation. Nature should be given a chance. What may appear as a crowded condition, as when the centrals erupt outside of and crowd the temporary laterals may be only nature's way of enlarging the arch by using the temporary laterals as fulcrums.

Never extract the temporary laterals to make room for the permanent centrals, nor the temporary cuspids to make room for the permanent laterals.

Occasionally when the permanent cuspids are prematurely erupted and have not space enough the 1st temporary molars may be removed, or the 2nd temporary molars may be extracted to make room for the 1st bicuspid. In these cases the temporary molars are larger than the bicuspids which follow them and their space may be slightly encroached upon without crowding the bicuspids.

## SURFACES.

MESIAL SURFACE-that which looks towards the median line.

DISTAL SURFACE-that which looks away from the median line.

LABIAL SURFACE-that covered by the lips.

BUCCAL SURFACE-that lying against the cheek.

LINGUAL SURFACE-the inner surface of the inferior teeth.

PALATINE SURFACE-the inner surface of the superior teeth.

## ERUPTION OF PERMANENT TEETH.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1st Molars | at | about | 6 | | years of | age |
| Central Incisors | " | " | 6 | to 8 | " | " |
| Lateral Incisors | " | " | 7 | " 9 | " | " |
| 1st Bicuspids | " | " | 9 | " 10 | " | " |
| 2nd Bicuspids | " | " | 10 | " 11 | " | " |
| Cuspids | " | " | 11 | " 12 | " | " |
| 2nd Molars | " | " | 12 | " 14 | " | " |
| 3rd Molars | " | " | 17 | " 21 or 35. | | |

PATHOLOGY is a description of diseased conditions.

The Disease or Pathological conditions to which the teeth are subject are:-

Caries.
Exostosis.
Abrasion.
Abnormal Dentinification of Pulp.
Atrophy.

Dental Caries is a chemico-vital process which, in its progress brings about disintegration and destruction of tooth tissue.

By Etiology of any disease is meant its cause and history.

Being chemico-vital part of the process is due to the vital forces and part to chemical action. It would seem that the vital forces control the chemical action to some extent and modify its character. They seem to render the progress by chemical action slower and limit it. The vitality however has nothing to do with the actual destruction but may render the tooth more liable to destruction at one time than another.

Chemical action affects the actual solution of the solid parts of the tooth, and seems to do so by displacing phosphoric acid and substituting some other agent.

To account for the phenomena of caries it is believed:-

1. The chemical agents are developed in the mouth.
2. They act in nascent condition.
3. They are developed in contact with the tooth.

There are two principal theories based on the Chemico-vital hypothesis:-

Watt's Theory.
Miller's.

## THEORY OF DR. WATTS.

Dr. Watts believes that dentine is destroyed by one of the following acids:-

Sulphuric.
Nitric.
Hydrochloric.
Acetic.

Sulphuric- leaves a black or carbonized surface.

Hydrochloric- dissolves away the mineral matter leaving the soft and leathery matrix.

Nitric- Animal matter dissolved away leaving part of the lime salts in a white chalky condition.

Acetic- Animal and mineral matter both dissolved away leaving little or no debris.

The presence of these acids he thus accounts for:

Sulphuric- By the oxidation of Sulphuretted hydrogen in the presence of moisture.

Nitric. By the oxidation of ammonia which is often found in the mouth.

Hydrochloric. By the decomposition of chlorides (such as lacl) in the presence of free Hydrogen.

Acetic. By the fermentation of certain foods. It is a fact that acetic acid is developed in the mouth as it is a stage in the passage of starch to the gaseous condition.

Unfortunately for this theory the salts which would result from these decompositions are not found in the mouth. Dr. Watts says they are dissolved in the fluids of the mouth. He believes that micro-organisms are found there merely because the cavity furnishes them with a suitable habitation.

## BACTERIAN THEORY--Dr. MILLER.

Since the cavities are always full of micro-organisms Dr. Miller believes that when once these Bacteria have obtained a lodgement by some defect in its development they multiply and develop, at the same time secreting an acid which is the active agent in the destruction of the tooth.

## THEORY OF DR. BLACK.

Dr Black's theory is a modification of that of Dr. Miller. He believes that the organisms are identical with the fermentation plant and hence cannot be cultivated in the absence of saccharine matter.

He says that the history of every living object exhibits the development of the being or plant and of a biproduct. In the development of the human body the biproducts are carbon dioxide and urea.

In the development of the micro-organisms (fermentation plant) found in dental caries the Biproduct is an acid which is either Lactic acid or else resembles it closely. The micro-organisms are found whenever saccharine matter is undergoing fermentation.

Typical Case. 1st. Molar with lack of coalescence of the islands of calcification so that there is an opening through the enamel to the dentine. In the opening thus formed a minute portion of sugar or starch finds a lodgement. This undergoes fermentation and micro-organisms are developed. The biproduct of this development is an acid which is developed in contact with the tooth substance, and acting in its nascent condition it destroys a very minute portion of the tooth. The supply of sugar being kept up by fresh additions, the minute cavity is enlarged, larger quantities of saccharine matter lodging there so that the process goes on with increased rapidity.

It is not known whether the enamel can be acted upon by the acid biproduct, but it is known the products of the caries in the dentine act upon it so as to hollow it out from beneath until it is finally broken down by external pressure.

DR. ABBOTT'S THEORY.

This is also known as the inflammatory theory, and is supported by Drs. Abbott and Bodecker of New York. It is believed by these that the odontoblasts retain the function which they originally possessed as cells and hence are subject to inflammatory action. They say that inflammation is set up by some irritant and that the tissue dies and is sloughed off.

The causes of dental caries may be divided into predisposing and exciting.

A predisposing cause is any force or influence acting upon the tooth and rendering it more liable to take on a diseased condition than it otherwise would have been.

Predisposing causes may be divided into-
Original and Accidental.

An original predisposing cause is a force or influence acting upon a tooth while in the process of development previous to its eruption rendering it more liable to become diseased than it otherwise would have been.

An accidental predisposing cause is some force or influence acting upon a tooth after its eruption into the mouth rendering it more liable to become diseased than it otherwise would have been.

The original predisposing causes are:-

1. Such defects in the development of the enamel as result in a lack of continuity of the protective covering of the tooth.
2. Defects in the quality of the enamel itself.
3. Heredity.
4. Mixture of races.
5. Climates- extreme heat and cold.

THE ACCIDENTAL PREDISPOSING CAUSES ARE:-

1. Decreased vitality either local or general.
2. Mechanical injury resulting in a loss of continuity of the enamel.
3. Badly performed dental operations either operative or mechanical.
4. Deposits of tartar.
5. Roots of teeth in the mouth.
6. Irregularity.
7. Pressure of the teeth against each other.
8. Want of cleanliness.
9. Acid conditions of the fluid of the mouth.

The Accidental predisposing causes are:-
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5. Roots of teeth in the mouth.
6. Irregularity.
7. Pressure of the teeth against each other.
8. Want of cleanliness.
9. Acid condition of the fluids of the mouth.

Two axioms may be laid down:-
a. A perfectly calcified and developed tooth is not susceptible to dental caries.
b. With a perfect physiological condition of the fluids of the mouth decay of even poorly developed teeth is impossible.

The exciting causes of Dental caries are acids. These have their origin from:--
1. Vitiated secretions of the mouth.
2. Abnormal secretions from the stomach.
3. Saliva.
4. Mucus.
5. Decomposition of animal or vegetable matter.
6. Acids taken into the mouth with food, or accidentally.

The liability of teeth to develop caries is according to the following order:--

1. Inf. Molars. ( 1. Receive little care.
2. Sup. " ( 2. Disturbance of nutrition.
2. Inf. " ( 3. Candies, &c., age.
2. Sup. Bicuspids.
Sup. Laterals.
Sup. Incisors.
1. Sup. Bicuspids.
3. Molars.
2n. Sup. Molars.
Inf. Bicuspids.
Inf. Incisors.
Cuspids.

After their eruption the 3rd Molars are soonest to decay. (Strain on system in school, &c.).

There are various types of caries:-
1. Penetrating.
2. Superficial spreading.

3. Spreading.
4. Arrested or retarded caries.
5. Calcareous.

In penetrating caries there is a small opening externally and extends towards the pulp in the direction of the enamel prisms and dentine tubules. This variety is most amenable to treatment.

In superficial spreading caries a large surface is attacked but the decay is not deep. A variety of this class is found on the labial and buccal surfaces and is due to chemical erosion.

In spreading caries there is usually a small opening through the enamel while the cavity spreads out on both sides beneath the enamel and the dentine. In this variety there is no particular tendency to penetrate to the pulp chamber.

Retarded or Arrested caries may be due to:-

1. The free use of antiseptics (smoking or chewing tobacco).
2. A return to a normal condition of the mouth which is . their vitiated condition have caused superficial caries.

The debris arrested caries is always dark in color and hard in consistency.

The debris of cavities usually follows one of four types:--

1. The Calcareous or chalky. This develops rapidly and is apt to recur. (Nitric Acid).
2. Walls clean and hard with very little debris when washed out. (Acetic Acid).
3. Inorganic matter dissolved away leaving leathery matrix. Hydrochloric Acid).
4. Black debris,--due either to retarded caries or (Sulphuric Acid).

It has been suggested that since the normal phosphates of lime are insoluble in the fluids of the mouth and the subphosphates are soluble that in the development of caries the phosphates are converted into subphosphates.

## PROGNOSIS OF RESULTS OF FILLING TEETH.

Unfavorable conditions.

1. Caries developed early in the history of a tooth or early in life.
2. Rapid development of caries.
3. Caries developed upon approximate and buccal surfaces of teeth and below the gum rendering them difficult to fill and difficult to keep clean.

4. A large portion of the crown already destroyed.
5. No systematic effort made by the patient to keep the teeth clean.
6. Crowded condition of the teeth.
7. Hopelessly decayed teeth remaining in the mouth.
8. Repugnance to visiting a dentist.
9. Unwillingness to pay a good fee.

## FAVORABLE CONDITIONS.

1. Cavities developed before maturity or late in life.
2. Caries developed slowly.
3. Caries on grinding or labial surfaces.
4. Teeth kept thoroughly clean.
5. Not much loss of tooth tissue.
6. Teeth standing slightly apart so as to be accessible readily, and easily kept clean.
7. Remaining teeth in good condition.
8. Patient visits the dentist regularly.

## TREATMENT OF DENTAL CARIES.

The treatment of dental caries should be in accordance with the etiology of the disease, and should consist in:-

1. The thorough removal of all disintegrated tooth tissue.
2. The hermetical sealing of the opening so as to exclude injurious agents.

To accomplish this a thorough examination of the cavity should be made. With a mouth mirror (not magnifying) and exploring instrument examine all suspected spots. If a cavity is suspected between the teeth where it cannot be seen it may be indicated by a light or dark spot. In these cases pass a smooth waxed thread between the teeth. If a cavity exists the thread will be either cut or roughened. Such cavities are most likely to occur between the bicuspids, the bicuspids and molars, and 1st and 2nd molars.

For purposes of study cavities may be divided into three classes:--

1. Those on Grinding surfaces.
2. Those on Buccal and Lingual surfaces.
3. Those on Proximate surfaces.

## CAVITIES ON GRINDING SURFACES.

These are due to diseased and never chemical erosion. As a rule they are simple. In preparing the cavity:-

1. The overhanging enamel should be cut away so as to give free access to the cavity as very little undercut is necessary.
2. Remove the debris with spoon-shaped excavators. They are least painful and leave the surface in the best condition.
3. If there are any radiating lines of defect they must be cut out so as to make a star-shaped cavity.
4. If the cavity is to be filled with gold good anchorage must be secured. A square corner enlarged is best.

Don't use an engine in opening up a cavity as it causes unnecessary pain by pressing on the contents. It may be used in trimming up the walls.

If the cavity on the grinding surface is large it is best to fill it at the bottom with zinc phosphate, after which it may be filled with gold.

## CAVITIES IN APPROXIMAL SURFACES.

In order to obtain free access to such cavities recourse must be had to

1. Cutting with chisel, file and corundum.
2. Separation of the teeth.

Separation may be either

a. Heroic or
b. Gradual.

Rapid separation may be effected by instruments such as Jarvis or Paris Separators, or by driving wedges between the teeth. Wedges are best made of compressed hickory and should be:--

1. Slightly concave in long direction.
2. " " from side to side.
3. Somewhat triangular to fit the V space at the neck of the tooth.

In using this wedge apply the rubber dam, then moisten the wedge with sandarac and drive to place with half a dozen good blows making a pause of few seconds between each.

For small cavities between incisors in your patients the blade of a lancet may be forced between the teeth at the cutting edge and the space thu gained kept by a wedge.

Gradual separation may be effected by the use of:-

1. Strups of rubber.
2. Compressed orange wood.
3. Cotton packed tightly into the cavity or between the tooth.

In applying rubber between the teeth place it where the edges of the cavity will keep it in place. Remove after 24 or 48 hours and keep the space by packing in cotton. Three or four days should elapse before operating to allow the tenderness to subside and if necessary to operat e sooner the tooth should be held firmly by ligaturing firmly to adjacent teeth.

In elderly patients teeth should not be separated.

In all elderly patients and in many younger ones it is desirable to obtain access to a cavity by cutting.

In the anterior teeth access should be obtained by cutting away the plantine surface unless the anterior wall is very thin. The labial surface should never be cut away in order to obtain access.

Where two centrals have adjoining cavities access may be had to both by cutting away the surface in the largest cavity. In the case of a lateral and central or a lateral and cuspid, the lateral as the weaker tooth should be spared and cutting made from the central or cuspid.

In a molar or bicuspid if the approximal cavity is of considerable size the grinding surface should be cut down as the tooth is otherwise subject to a recurrance of caries.

CONTOURING. Contouring is the reproduction of the size and shape of the original tooth. The better the quality of the tooth the greater is the indication for contouring and vice versa. "The more a tooth needs filling the less it needs contouring". (Flagg).

Fillings in teeth of middle aged persons should be contoured.

Fillings in teeth of young patients with teeth strongly predisppsed to caries should not be contoured. In these cases it is desirable:--

1. To permanently separate the teeth.

2. To make a space between them as will readily be washed by the fluids of the mouth.

Permanent separation may be effedted by leaving the teeth in contact at the necks and cutting them apart above.

Simplesepartion without contact may be permanent but it/ liable to be closed by the orelusion or the eruption of the wisdom tooth forcing the other teeth forward.

A Self-cleansing space may be made by cutting a V shaped space between the teeth on the lingual side.

Chewing gum for 15 minutes after each meal will assist in keeping the tooth clean.

Access having been obtaines all debris and softened or disintegrated dentine should be removed. After this the cavity should be shaped to retain the filling. The ideal would have:-

1. Retaining groove at the cervical wall.

2. Lateral retaining grooves.
3. Widened base to prevent the filling being lifted up

A thin edge of cementum often projects up at the cervical wall. This should be cut down until quite thick and then leveled outwards.

The lateral retaining grooves should be cut in the dentine beneath the enamel.

In all cavities the orifice should be carefully prepared so that all softened tissue is thoroughly removed and the filling rests against the solid walls.

## CAVITIES ON BUCCAL AND LABIAL SURFACES.

These are of three kinds:-

1. Cavities at about the centre in the median line, caused by lack of coalescence of the islands of calcification. These are very simple and easily filled. Similar cavities are sometimes found upon incisors. They should be cut out so as to be round or oval in form so as not to be unsightly.
2. Cavities at or near the union of the enamel and cementum extending transversely across the tooth. They are difficult to treat and caries frequently recur. The chief danger is at the lateral edges and here they should be well cut out with a burr until sound tissue has certainly been reached. They should be filled with Gutta Percha or copper amalgam.
3. A saucer shaped cavity due to chemical erosion of the enamel. It begins as a white opaque spot which gradually enlarges. Unless a radical change can be made in the fluids of the mouth and treatment is palliative only as the decay around the filling will continue. For these cavities in posterior teeth copper amalgam makes the best filling. It does not change its form.

## MATERIALS FOR FILLING.

An ideal filling should be:--

1. Absolutely insoluble in the fluids of the mouth.
2. Not acted upon chemically by fluids or other agents found in the mouth.
3. A poor conductor of heat or thermal changes.
4. Plastic and easily adapted to the walls of the cavity.
5. A substance that will adhere to the walls of the cavity.

6. A substance that will undergo no change of form after introduction into the cavity.
7. Hard and tough enough to resist mastication.
8. A substance that will exert no therapeutical action
9. Not easily affected by moisture in filling.
10. Of a color resembling the teeth.
11. Susceptible of a high polish so as to be easily kept clean.

Gold possesses many of these but is a good conductor of heat.

Amalgams change their form after insertion into a cavity.

Zinc chlorides and phosphates are soluble in the fluids of the mouth and therefore are not permanent.

In regard to permanency materials might be arranged as follows:--

Gold.
Tin.
Amalgams.
Zinc phosphates.
" chlorides.
" sulphates.
Gutta percha.

AMALGAMS:- Dental amalgams consist of a combination of Mercury with some other metal or metals which crystallizes into a solid mass. The best amalgams consist of about equal parts of Silver and Tin with 2 or 3% each of Gold and Platinum.

Tin gives amalgam density and stability of color but has a tendency to assume the spherical form and especially if an excess of Hg is used.

Copper is useful in preserving tooth tissue and gives the amalgam strength but turns black. It gives stability of form.

Gold controls the tendency to assume the spherical form, and gives it toughness and edge strength.

Platinum decreases the liability to assume the spherical form, makes it harder and causes it to crystallize more readily, but has a tendency to make the amalgam brittle. It gives it fine grain.

Zinc is added to prevent discoloration and to control shrinkage. It causes amalgams to have little edge strength.

FORMULAE.

| Name | Sn. | Ag. | An. | Pt. | Cu. | Zn. | Sb. |
|---|---|---|---|---|---|---|---|
| Arrington | 58 | 42 | | | | | |
| Flagg's Submarine | 43 | 50 | | | 7 | | |
| " Facing | 42 | 50 | 5 | | | 3 | |
| King's Occidental | 55 | 42.5 | | | | 2.5 | |
| Willmott's | 45 | 45 | 2.5 | 2.5 | 5 | | |
| Chase (White) | 40 | 50 | | | | | 10 |
| Fletcher's (Eng) | 50.35 | 42.35 | 3.35 | 1.30 | 3.65 | | |
| Flagg (contour) | 38 | 56 | 6 | | | | |
| Globe (S.S.W.) | 52.36 | 45.74 | 1.50 | .40 | | | |
| Lawrence (New) | 51.50 | 44 | | | 5.50 | | |
| Stirling | 62 | 33.57 | | | 13 | 4.34 | |
| Townsend | 55 | 44 | 1 | | | | |
| Welsh G.& P.) | 51 | 47 | 1.60 | .40 | | | |

To obtain the best results from amalgam:-

1. Do not use an excess of mercury.
2. Insert the filling as soon as possible after amalgamation.

(Royal Mineral Sensidanium)

MANUFACTURE OF AMALGAMS.

The Tin is melted first covered with charcoal and when at a temperature of about 600o the Pt is dropped into it. A chemical combination is formed and after pouring into ingots and cooling it is broken into small pieces. The An. and Ag. are then melted together in a clean crucible and the surface sprinkled with powdered charcoal. It is then agitated and the broken bits of Sn. and Pt. are dropped into it and the whole mass thoroughly mixed and poured into a cold ingot. It is then filled up and the filings mixed so as to make the mass homogeneous. The small particles of iron are removed by a magnet. Amalgam filings should be excluded from the air so as not to become oxidized.

COPPER AMALGAMS.

Copper amalgam is supplied already in combination with mercury.

The copper is precipitated from a saturated solution of copper sulphate and the copper as it is precipitated unites with the Hg. at the bottom of the vessel and adheres to a pure bar of iron which stands upright in the vessel. It is scraped off and the iron thoroughly washed out with $H_2 So_4$ and the excess of Hg. squeezed out. Then worked into a mortar and the excess again squeeged out and then allowed to crystallize in the form of disks.

It is prepared by heating in an iron spoon until little globules of Hg. just begin to exude when it is rubbed up in a mortar and the excess of Hg. squeezed out.

Advantages claimed:-

1. Does not change its form.
2. Special advantage for cavities shallow and broad. But it discolors.
3. It exercises a therapeutical action on bacteria; i.e. they inhibit also.

ADVANTAGES OF AMALGAMS,

as a filling material:-

1. They are plastic and readily introduced and adapted to the walls of the cavity.
2. They are not easily affected by moisture in introduction--especially copper amalgam.
3. They are not soluble in the fluids of the mouth.
4. They are hard enough to resist mastication.
5. Practically they exert no therapeutical action--subject to rare exceptions.
6. Poorer conductors than gold.
7. They are cheap.

OBJECTIONS:-

1. The chief objection is their tendency to change their form.
2. Most of them discolor.
3. Some of them have no edge strength.

GOLD FOIL. Gold foil must be made from chemically pure gold. It is refined by what is known as the

Wet Process. The gold with any impurities is first dissolved in Aqua Regia and the solution filtered, and evaporated to a syrup after which it is allowed to crystallize forming Terchloride of gold. This is dissolved in water, washed thoroughly, and the water evaporated. The Terchloride is again dissolved in water and a solution of sulphate of Iron chemically pure is slowly added to it until all the gold is precipitated as a brown powder. The liquor is decanted off and the sediment boiled in dilute $H_2SO_4$ after which it is washed and melted into ingots.

In the manufacture of foil the gold is remelted and poured into ingots about one (1) inch wide and 1/8 inch thick. These are hammered to give them toughness and then rolled out into a long ribbon one inch wide and of a thickness corresponding to the weight of the foil to be made. This ribbon is cut up into squares allowance being made for waste. These squares are annealed and piled up with alternate layers of parchment to the number of 180. This forms a "cutch" about 4 inches square and 2 1/2 inches high. The cutch is put in a leather case to hold it firmly and beaten for 2 hours with a 15 lb. hammer until the gold is 3 inches square. The cutch is then annealed, the gold removed and 360 squares of gold piled up between layers of gold beaten skin and pounded with a lighter hammer for f hours until the pieces of gold are about 5 inches square. They are then annealed in an oven if cohesive foil is to be made, trimmed and placed in books for sale.

Gold foil may be either soft or cohesive. In reality the cohesive foil is softer than the soft as the annealing softens it.

## CORRUGATED FOIL.

Corrugated foil has a wrinkled surface. It is said to have been discovered at the Chicago fire. It is prepared by heating the gold leaf between leaves of mica strongly.

Advantages:--

1. It is very soft.
2. Easy of manipulation. The edges do not curl up if the centre piece is condensed.

Disadvantages:-

1. Not as cohesive as plain foil.
2. Does not become so homogeneous and is more likely to become pitted and roughened.

In using corrugated gold condense the surface to some little depth with broad instruments with fine serrations and burnished well before it gets wet.

## GOLD PELLETS OR BLOCKS.

These are prepared by piling up a number of leaves of pure gold and pressing them just enough to make them cohere without welding them. They are then cut up into strips with a razor edve or fine saw and still further cut up into pellets which are square and have the advantage of not having their edges welded.

## GOLD CYLINDERS.

These are usually made of corrugated foil by winding the sheet around a fine steel needle or spindle, withdrawing the needle and cutting the cylinder into lengths as required, by a circular saw.

## MATS OR RIBBONS.

These are prepared by folding the gold in a fan-shape ( ) and supplying it either in the form of ribbons or cut up into mats.

The advantages of using machine made pellets,&c,are:-

The advantages of using machine made pellets, &c., are:--

1. They have not been handled by the fingers and are clean.
2. The masses are homogeneous and the edges are not welded.
3. Valuable time is saved.

CRYSTAL GOLD.

Two varieties are on the market, Watts' and Struvois'.

Watts' crystal gold is prepared by obtaining a precipitate from a solution of Terchloride of Gold by the action of electricity. The gold is precipitated as a feathery mass of crystals. These are thoroughly washed, dried and compressed into a spongelike mass.

Its advantages are:--

1. In skilful hands can be rapidly introduced.
2. Packs readily and condenses directly before the instrument without curling up at the edges.
3. Stays where you put it and is therefore very useful in starting fillings.

DISADVANTAGES:--

1. It has not sufficient toughness and strength to make a good contour filling.
2. It is apt to ball up and close the opening of the cavity.
3. It is difficult to adapt into undercuts.
4. Requires more skill than foil.

A more perfect crystallization of the gold can be obtained by mixing it with 6 to 12 times as much Mercury, subject it to a gentle heat for a short time when it will have become crystallized. Then remove the mercury with dilute nitric acid. Wash out the nitrate of mercury from the gold and bring to a full red heat in a muffle. It is then ready for filling. (Dictionary).

Non-cohesive foil is pure gold which cannot be made cohesive by being heated.

TINFOIL. Prepared from pure tin by rolling, beating, &c., similar to gold.

Advantages:--

1. Considerable plasticity.
2. Poor conductor of heat.
3. Hardens the enamel around the filling. Useful in filling children's teeth.

DISADVANTAGES.

1. Difficult to introduce.
2. Soft and does not resist mastication.
3. Patients won't pay for them.

ZINC SERIES. Of this series there are three classes:-

1. Oxyphosphates.
2. Oxychlorides.
3. Oxysulphates.

Oxide of Zn. is the basis of them all. The heavy zinc oxide for dental purposes is obtained by precipitation. A weak solution of mixed sulphate of zinc and carbonate of soda is made from which zinc carbonate is precipitated and falls to the bottom. This precipitate is then strongly heated until the water and CO2 are driven off leaving a pure heavy dry zinc oxide.

Extraneous matter is added to the zinc oxide:-

1. To give it increased hardness.
2. To facilitate its setting.

The powder of the zinc phosphate and zinc chloride series are very similar and may be interchanged. Each consists of zinc oxide along with silex or other weighting material.

| | | |
|---|---|---|
| Zinc Oxide | 55 parts | These might be the proportions. |
| Silex | 2 " | |
| Ground Glass | 1 " | |
| Borax | 1 " | |

These would then be calcined at a white heat to form an oxide.

The fluid of the phosphate series is Glacial Phosphoric acid. It is prepared by dissolving in water and then boiling the solution until it is of the consistency of a syrup.

Aluminum Oxide and Magnesium Oxide are sometimes added to increase the hardness and to facilitate setting.

An oxychloride may be distinguished from an oxyphosphate by the taste of the fluid.

Oxychloride fluid is astringent.
Oxyphosphate " " acid.

Oxyphosphates are better than chlorides:

1. They are less irritant to the pulp and to sensitive dentine.
2. They are harder.
3. They are less soluble.
4. They adhere more firmly to the dry walls of the cavity

The fluid of the oxychloride series is prepared by making a saturated solution of chloride of zinc in water. It can be best made by allowing the crystals to deliquesce in the air.

Oxy. chloride does not answer for a permanent filling as it is soluble in the fluids of the mouth and soon wears away. It is useful as a root filling because:--

1. It is easily adapted to the walls of the root canal.
2. It is strongly antiseptic.

## ZINC SULPHATES.

Zinc Sulphates are mixtures of Sulphate of Zinc and Oxide of Zinc and are prepared for use by mixing them in water in which a little gum arabic has been dissolved. Zinc Sulphates are only used as a capping material. There are two preparations:--

Weston's non-irritating Cement.
Fletcher's Artificial Dentine.

## OXYCHLORIDES.

Fletcher's Enamel.
Smith's Os Artificial.
Agate Cement.
Acme.

## OXYPHOSPHATES.

Fletcher's Artificial Dentine.
Weston's Insoluble Cement.
Calks Diamond Cement
Welch's Cement.
Ritcher's Harvard Cement.

Slab should be cold if time is desired to insert.. The warmer the surroundings the quicker the filling hardens.

## ELECTRO GALVANIC ACTION.

The Electro Galvanic Theory of the recurrence of caries around a filling is based on the supposition that when a metal filling is introduced into a tooth we havea Positive and Negative element and a fluid capable of acting on one of them.

The pos. element is the one acted upon by the fluid.

If gold is inserted in a tooth being less readily acted upon than the tooth it constitutes the Neg. element and the tooth the pos. element and as electrical action is set up the tooth is dissolved away around the filling.

If tin is used in a fairly good tooth the tin is less resistant than the tooth so that the tooth becomes the negative element and the tin the pos. element so that the tin is dissolved away while the tooth is preserved.

In very badly formed teeth however, the tooth may be less resistant than the tin and therefore becomes the positive element and consequently recurrence of caries will take place.

## GUTTA PERCHA.

Gutta percha is obtained from the piece of a tree which grows in the E. Indies. The trees are cut down and the mucilaginous substance scraped from the inside of the bark and outside of the wood. This is evaporated to hardness and ground to a pulp, after which it is washed to remove impurities and pressed into a solid mass. It is of a grayish white color and is hard at ordinary temperatures but becomes very plastic in boiling water.

Advantages:--

1. Insoluble in the fluids of the mouth.
2. It is very plastic when warm.
3. Poorest conductor of heat.
4. It resembles the teeth in color.
5. It preserves the teeth well.

Two serious objections:--

1. Does not resist mastication.
2. It is very elastic when warm and changes its form.

-Hill's Stopping.-

| | |
|---|---|
| Gutta Percha | 1 part. |
| Quicklime | 2 " |
| Feldspar | 2 " |

Probably the best preparation of Gutta Percha is Flagg's Hand-made Gutta Percha.

Gutta Percha may be used:--

1. In buccal cavities especially if they extend beneath the gum.
2. In approximal cavities.
3. In labial cavities on the lower incisors
4. In children's teeth as provisional fillings.

**PULP CAPPING.** Before capping a pulp either:--

1. Remove all softened dentine, or
2. Thoroughly disinfect with Hg Cl2 (1 in 500).

If a small portion of the pulp is freshly exposed moisten a piece of writing paper in creosote and lay it over the opening. Cover this by flowing zinc sulphate over it. The advantages of Zn, SO4 for this purpose are that it is astringent, stimulating and antiseptic.

In preparing the zinc sulphate take a little of the American preparation and add it slowly to a little water on a slab. When of a semifluid consistency flow it over the bottom of the cavity to a considerable thickness. After it has hardened it may be excavated partially and the cavity filled with a phosphate or amalham filling.

Zinc chlorides are sometimes used in order to utilize their antiseptic and irritating properties. They should never be applied directly to an exposed pulp but if a thin layer of dentine intervenes the irritation of the pulp which they cause stimulates the deposit or formation of secondary dentine.

Zinc chloride should be introduced in a very fluid state and the moisture absorbed with bibulous paper.

Exposure of a pulp may be diagnosed by "sucking".

If sucking causes pain there is an exposure of a li live pupl.

ZINC PHOSPHATES.

Zinc phosphates are used:--

1. In children's teeth.
2. Where the shape of a cavity is not favorable for the retention of a filling.
3. In hypersensitive teeth as a temporary filling.
4. To fill the bottom of a large cavity.

A zinc phosphate filling is not antiseptic and the cavity should be thoroughly disinfected before inserting the filling. If the creosote or carbolic acid is used cleanse the surface with alcohol.

1. Excavate the cavity thoroughly.
2. Disinfect the creosote or carbolic thoroughly.
3. Cleanse the surfaces with alcohol.
4. Mix the phosphate thoroughly and rapidly.
5. Introduce in the form of a ball.
6. Trim and burnish with a very fine disk before it hardens. (or after).
7. Protect from moisture until hard.

Fletcher's Eng. prep. is the most permanent phos. prep in use.

Weston's insol. cement takes a good polish. 1891.

## GUTTA PERCHA.

In inserting a gutta percha filling one point must be securely anchored and the rest attached to it or else it will leak all round. This anchorage is obtained either by a retaining point or by a sharp angle.

1. Soften always over hot water on a tray.
2. Have the cavity and the material perfectly dry.
3. Anchor a portion of the filling and build the rest to it in small portions.
4. Trim with a heated instrument or with cotton dipped in chloroform. Such a piece of cotton may be drawn between the teeth.

It cannot be used for capping.

## AMALGAM.

The great objection to amalgam fillings is that they always change their form after introduction into the cavity. When mixed with mercury (Hg) the filings form a chemical combination, but the combination does not take place in definite proportions.

To get the best results:

1. Place the mercury in a wadgewood mortar and add a little of the powder and rub into a thin paste. To this add filings from time to time continuing the rubbing until a somewhat granular mass is obtained. It should be smooth, homogeneous and perfectly amalgamated. (Amalgams containing zinc or Platinum should be made slightly coherent.)
2. Condense in a Fletcher's compressor into disks, or cylinders.
3. Insert into the cavity immediately after Amalgamation.
4. Pack with ball-faced instruments.
5. Use the instrumsnts with a sliding motion so as to rub the amalgam into contact with the walls.
6. If free mercury comes to the surface (which shows that an excess has been used) wipe it off and add fresh material continuing this process until all the free mercury has been absorbed.
7. After the filling has become hard polish it carefully.
8. Use the best amalgams and preferably the same one.

In mixing an amalgam if an excess of Hg has been used add filings enough to absorb it. Squeezing is injurious probably because the Hg squeezed out contains some of the more soluble materials (gold and tin) and thus breaks up the proper peoportions.

## SOFT GOLD OR TIN FOIL.

The manner of inserting a tin foil filling is exactly similar to that of inserting a soft gold filling.

The principle involved in the introduction of a soft gold filling is not anchorage but wedging. Soft gold should be entirely non-cohesive. Its advantages are:-

1. More readily adapted to the walls of cavity and therefore less liable to leak.
2. More readily introduced into large cavities.
3. Poorer conductor of heat.
4. Less apt to break frail margins of cavities.

The foil may be cut up into ribbons or what is better part of a sheet may be doubled up and cut into short lengths and then rolled between the fingers to form pellets of about the size and shape of a grain of rice.

Overhanging walls on both sides are a necessity. The rice shaped pellets are set up on end in the bottom of the cavity and when the bottom is covered a mop shaped instrument is forced into the centre and the gold forced apart against the walls. Another pellet is introduced to fill this space and the wedging repeated until a complete layer has been formed when the whole is condensed. Another layer in introduced in the same manner and if the cavity is deep a third may be necessary. The last tier of pellets should project from the cavity and in finishing the outer pellets are bent inwards and the whole thoroughly burnished and polished.

In filling an approximal cavity the same general method is employed but the pellets are introduced in such a manner that the outer ends stand up more than the inner.

Soft fillings do not polish equal to cohesive. Tin will preserve a tooth better than amalgam and is especially valuable in filling children's teeth. It does not change its form and the salts formed around the filling permeate the teeth for a short distance and antisept and preserve them. These salts even fill in slight defects around the filling. It is a poor conductor of heat and is tolerated in children's teeth, the pulps of which would die under a gold filling.

## COHESIVE GOLD.

1. Sheet gold may be prepared for filling by rolling it and cutting into pellets which are practically cylinders.
2. It may also be folded into ribbons and cut up, but the cylinders are more easily handled.
3. It may be crimped between two sheets of brass, each with a narrow flange at one end.

Pellets prepared by machinery that have never been handled are best annealed upon a tray over an alcohol lamp. Hand-made pellets should be passed through the flame of an alcohol lamp to burn away any foreign matter that may be adhering to them.

Anchorage is the fundamental principle of a cohesive gold filling. This is obtained by drilling one or more retaining pits. These should be drilled with a square pointed drill, and if the gold will have to resist a considerable strain it should be slightly undercut, and have its outer edges countersunk to prevent the point of gold breaking off.

Retaining pits need not be deep, 1/64 of an inch is sufficient depth. If possible get two good retaining pits or one good one, and a square offset against which to pack the gold. To fill the retaining pit use a fine long pointed hand instrument, a little smaller than the pit. Carry one end of a small strip down to the bottom of the pit and condense. Then loosen the point by turning it slightly and without removing entirely carry down another part and condense. When the pit is full condense thoroughly and make a sort of cap to project over the edges.

Avoid grinding off the edges of the pit, as the final powder thus formed will interfere with the welding of the gold. For this reason an automatic plugger should not be used in filling retaining pits. In any case after the pit or pits have been filled, the gold should be packed along the bottom of the cavity forming a solid bar, to which the rest may be attached.

and As soon as the lower part of the filling is introduced the cervical margin covered it should be finished. In a bicuspid tooth the cervical border is concave on each side and to finish the filling to this contour, special trimmers (Rhicns) may be used. It should then be burnished with smooth instruments, after which the rest of the filling may be done.

## SUGGESTIONS.

s that are curved so that thepoint

1. Use plugger pointd that are curved so that the point

2. Use either finely serrated points or smooth ones with sharp edges.
3. Introduce the gold in small pieces and condense each thoroughly.
4. From first to last the points most difficult of access should be filled first.
5. Have the filling project slightly to allow of trimming.
6. After thoroughly condensing the surface with a foot or other plugger, burnish with a smooth steel point using considerable pressure and going over the surface repeatedly. Then trim with a disk or otherwise; and burnish again. Then trim and polish. All this must be done dry.
7. Trim with a disk whenever practicable.
8. Polish with emery, pumice and polishing rouge.
9. After the surface is perfectly polished, if in an anterior tooth, deaden it by rubbing with a stick dipped in pulverized pumice.

## DRYING A CAVITY AND KEEPING IT DRY.

For drying a cavity 4 materials are used:-- Spunk, Bibulous paper, Japanese paper and Absorbent cotton. Absorbent cotton not only absorbs water more readily, but can be introduced on the point of an excavator. Borated Absorbent cotton is preferable. The best raw cotton is boiled in Caustic potash to remove the grease, and then treated with Boracic Acid.

Spunk takes up the moisture very thoroughly, but not rapidly, and has the advantage of turning black when wet.

## KEEPING THE CAVITY DRY.

Napkins are useful but may be overdone. They act as a stimulant to the salivary glands, and hence cause an increased flow of saliva.

Seabury and Johnson manufacture napkins at $2.00 per 100, which can be cut up into a number of pieces, and answer every purpose.

A napkin may be used:--

1. Between the teeth and cheek; and the teeth and tongue of the lower jaw.
2. Between the teeth and cheek of the upper jaw.
3. To lay over the lower lip when using the rubber dam; and thus prevent the saliva running down the lip.

RUBBER DAM. -Dr. C. S. Barnum, of New York, inventor, about 1860.

Rubber dam is composed of thin sheets of slightly vulcanized rubber. Holes may be punched in it, either by a rubber dam punch but preferably by stretching it over the well rounded head of an excavator, and cutting it with a sharp knife. The centre of the hole will be directly over the centre of the instrument, and the size will depend upon the distance from the end at which it is cut. In cutting large holes strike the rubber with a sharp nick in cutting. Have the holes nearly as far apart as the centres of the teeth over which they are to be placed.

In inserting the dam have the edges of the seppum pass in first. This is the secret of applying the rubber dam. If the teeth are very close together, and the dam cannot be forced between them, both sides of the rubber mat be smeared with a little soap.

The dam should be tied about the tooth to be operated on, and usually upon the one on each side:--

Cocoaine. 1. To keep the rubber from slipping.

2. To avert the edge of rubber and thus prevent leakage.

In applying the dam to the Ant. teeth, it is most readily done by working from right to left.

Stenos duct may be closed:--

1. By drawing it out with a pair of pliers, and tying with a piece of strong thread. Machine linen thread No. 30.

Cocoaine. 3. By drying the opening and then holding a tightly compressed pellet of absorbent cotton or bibulous paper over it.

3. By pipe clay buttons (invented by Geo. W. Snow, of Buffalo, N. Y.) which, when quite dry, will adhere to the cheek around the opening. They may be held by the fingers or by springs.

SALIVA EJECTORS.

A saliva ejector of some kind is an essential article in every well equipped dental office. They are of two kinds:- Those that can be used where there are no waterworks and those that are attached to taps of waterworks.

The first variety consists of a small glass tube about 36 inches long, and just large enough to allow a drop of water to fall through it. At the upper end of this is a funnel containing a quart or so of water, and it terminates below in a basin to catch the water. A tube from the mouth piece opens into the inside of this glass tube. The water falling drop by drop carries the air along with it; and creating a partial vacuum above it to which the suction is due.

The water pressure ejectors are very simple. It consists of a tube, connected with the tap presenting a constriction at some distance from it. A smaller tube connected with the mouthpiece passes through the side and terminates just before reaching the constriction.

## MATRICES.

A matrix is an appliance by which the missing approximal wall of a cavity may be supplied; and a compound cavity thus converted into a simple one.

The difficulty is that teeth have not parallel walls; but present the variations:--

1. They are larger at the crown than at the neck, and therefore more or less bellshaped.

2. The cervical wall is concave from side to side.

Unless the matrix fits the cervical wall it is not much value. Various forms have been introduced. Perhaps the best is a file from which the temper has been drawn, and which has been so bent as to fit the concavity of the cervical wall; and at the same time bent outward above so as to represent the natural convexity or contour of the touth. This is wedged in place.

## COMPOUND FILLINGS.

It is believed by many that a filling composed of two metals will preserve a tooth better than one alone. The theory is that the electrical action exerts itself upon the metals instead of the tooth.

To get this advantage, the gold must be brought into contact with soft amalgam. A gold facing put upon a hard amalgam has no advantage, but an amalgam patched upon a gold filling has the advantage referred to.

In making a compound filling pack soft amalgam into the lower fifth of the cavity so as to cover the cervical wall (if in proximate surface). Then press gold into this which at once takes up the mercury and becomes the color of the amalgam. Continue to do so until the gold retains its natural color. Then fill the remainder of the cavity as in an ordinary cohesive gold filling. Do not attempt to finish off the filling at the same sitting, as the mercury will be rubbed over the gold to form an amalgamated surface.

It discolors the tooth badly and the amalgam turns black. Amalgam will always turn black if it extends to a gold filling.

## TREATMENT OF CARIES INVOLVING THE PULP.

The first symptom that caries has progressed readily to a pulp is a susceptibility to thermal shocks. After this condition has existed for some time the pulp becomes hypersensitive, so that the slightest variation from normal conditions causes more or less pain. At such times also an unusually severe pain may be occasionally felt.
This may be due to:--

1. Mechanical irritation,-as pressure of food.
2. Chemical irritation,-as from a grain of sugar.
3. Thermal changes.
4. Systematic depression.

The pulp being strongly predisposed to inflammation systematic depression arising from a cold, overwork, &c., may cause violent pain. This is most often felt at night, as the recumbent position facilitates a determination of blood to the part.

In order to diagnose the condition the patient should "suck" the cavity: If sucking produces pain there is an exposure of the pulp. If very slight suction causes intense pain either:--

1. The exposure is very large.
2. The pulp is hypersensitive.

Prognosis will depend:--

1. Upon the exciting cause.
2. Extent of exposure; if any.
3. Length of time it has existed.
4. Condition of the system.

1. If the exciting cause of the pulpitis is mechanical or chemical irritation the prognosis is favorable, as these can be readily removed. If malaria or Syphilis; it is very unfavorable. If an ordinary cold it will depend upon the length of time necessary to restore the patient to health.
2. If the pulp is actually exposed the greater the extent of the exposure the less favorable will be the prognosis, as it is impossible to bridge over

a large opening without irritating the pulp.

3. If the pain has been felt from time to time for a considerable period, the prognosis is unfavorable. If felt for the first time it is favorable. Patients as a rule, though, lie like the Deuce (Hipple)
4. If the patient has a strong healthy constitution, the prognosis is much more favorable than if the patient has only low vitality.

The pain of pulpitis is due to the determination of blood to the part giving it a tendency to swell. Swelling however is prevented, and the congested bloodvessels pressing upon the hypersensitive nerve filaments causes intense suffering.

TREATMENT.

1. Relieve the pain.
2. Remove the cause if possible.
3. Resolve the inflammation.
4. Protect the pulp.
5. Fill the cavity.

1. To relieve the pain the pungent hydrocarbons, such as creosote, oil of cloves (Carbolic acid) &c. are used. They act as Stimulants and Astringents; and by contracting the vessels and pulp, lessen the pressure on the nerve filaments, and so relieve the pain. In applying them remove any debris from the cavity with a jet of warm water and an excavator if necessary. Complete excavation should not be made, as the pulp frequently projects up through the opening into the pulp chamber, and so it is liable to be noculated with septic excavators, in which case it always dies. The cavity should then be dried, as the hydrocarbons are not soluble in water, after which the remedy may be applied. The cavity should then be sealed up with cotton and sandarach varnish.

2. The cause of mechanical or chemical is removed with the washing out of the cavity. If systematic, Tonics or other remedies may be made use of: Carthartics, Diuretics, Diaphoretics as required, lessen the arterial pressure.

3. The inflammation is resolved by the use of the same agents which relieve the pain.

4. If there is not an actual exposure, if the attack is recent and the other conditions favorable, the pulp may usually be preserved. All softened debris is first removed by the use of sharp, wide-faced, spoon excavators. A layer of softened dentine should not be left over the pulp:-- Because,

It is full of micro-organisms which cannot readily be thoroughly disinfected.

If there is no exposure cover the nearly exposed point with a small piece of paper saturated with Oil of cloves or creosote. Then fill the cavity with Zinc phosphate. Zinc Chloride sets up too much irritation usually and leads to death of the pulp. The cavity may be partially filled with metal; but preferably this should be left for a few months.

If there is actual exposure excavate all softened debris as before (but not at first sitting of course) with sharp, wide, spoon-shaped instruments. Then trim the edges of the opening into the pulp chamber smooth with the same instruments. The tract should be disinfected before excavating, to prevent septic matter finding its way into the pulp. Then proceed to cap the pulp by dipping a piece of good paper in Oil of cloves and laying it over the opening, covering it with a larger piece gummed with Fletcher's carbilized resin so as to make it adhere to the walls of the cavity. In deep cavities this may be covered with a third. Don't cap a pulp in a cavity where you can't see what you are doing.

## ODONTALGIA.

Odontalgia may be caused by:--

1. Acute pulpitis.
2. Acute periostitis.
3. Pulpitis and periostitis combined.

In the treatment of pulpitis, in order to save the pulp, the following would be favorable conditions:--

1. Pain not severe and infrequent.
2. Caused by mechanical or chemical irritation, and not by constitutional causes.
3. No exposure of pulp or very slight.
4. General good health.
5. In case of exposure if the pulp has not bled.

In regard to the causes of those that are constitutional, act by obstructing the excretory organs.
This obstruction may be caused by cold, fatigue, &c.

The effete matter is thus retained in the blood and acts as an irritant whenever there is a predisposing cause.

There is no such thing as taking cold in a tooth. Toothache from a cold is merely a local manifestation of a constitutional disturbance.

To relieve the constitutional causes prescribe:--

1. Rest.
2. Remedies which will quicken the excretory organs as required, such as Cathartics, Diaphoretics, Diuretics, &c. A turkish bath would answer the purpose; or the patient mught bathe the feet in hot water, take a hot drink, take a Dover's powder and go to bed. Hydragogue cathartics reliece the arterial tension; and thus reduce the inflammation.

Do not treat and fill at the same sitting.

When the filling will not be subject to trituration; use Gutta Percha as a filling material. It is less irritating than the phosphates.

## DEVITALIZATION.

A pulp may be devitalixed:--

1. By direct mechanical violence.
2. By the use of therapeutic agents.

In devitalizing with arsenic use a mixture of arsenious acid and muriate-heavy; Morphia equal parts made into a paste with creosote or Oil of cloves.

1. Excavate with broad faced excavators until a clean exposure is obtained.
2. Use only a small quantity of the arsenic.
3. Seal the arsenic in the cavity so that it cannot escape; careful that none is squeezed out.
4. Allow the arsenic to remain for 24, or better, 48 hours. A less time, however, is sufficient for children.
5. Do not attempt to remove the pulps at once, but break it up with a probe and leave for a few days until the prolongations into the tubuli have become soft. Pain- extreme, caused by vigorous blood supply and hence vigorous blood pressure against the nerve--severe pain is a good sign--complete death.

## MANNER OF DEVITALIZATION.

Arsenious acid destroys the pulp by causing strangulation and death by congestion. It acts as an escharotic and destroys the tissue immediately in contact with it by combining chemically with it. A violent inflammation is set up in the deeper portions which causes a marked determination of blood to the part. At the apex of the root the canal is constricted and transmits an artery vein and nerve. The artery expands and presses against the vein, so that it collapses and causes stasis of the pulp. Pressure upon the nerve and nerve filaments causes the pain. As a result of the stasis the pulp dies and becomes disorganized. In the meantime the pressure upon the nerve paralyzes it and causes the pain to cease. It sometimes partially returns, however.

Partial death of the pulp is due to the fact that the vein does not always close altogether, a circulation continues through the larger vessels at some distance from the point at which the arsenic is applied. In such cases it is never wise to make a second application of arsenic, as it is liable to pass through the tubules and set up periosteal trouble. The better plan is to remove the dead portion, apply a disinfectant and seal up for a while, as the pulp will finally die. Partial devitalization is due to:--

1. Abnormally large apical opening.
2. Partially devitalized pulp.

The more healthy the pulp the more readily it can be devitalized. The pain is proportionate to the hypersensitiveness of the nerve filaments.

Do not attempt to remove a pulp with a broach within a week or ten days after devitalization. In removing insert the broach at the side of the pulp canal; pass it gently up to the apex; rotate it in one direction, and withdraw. Do not use too fine a broach. It is not essential that the broach goes up to the apex.

The entire pulp can rarely be removed from the superior 1st. Bicuspids, Buccal roots of Sup. Molars and Mesial roots of Lower Molars.

If the pulp is entirely removed, fill the apex with cotton and creosote. Cut off the end of a Nicholson broach and flatten the end slightly. Dip it in creosote and wind a few fibres of cotton around it. Carry up to the apex of the Root and pack the cotton withdrawing the broach by rotating backwards and packing again. Repeat this process with other pieces of cotton until the root is filled up to a point readily accessible. Then use cotton saturated with thin oxychloride cement. If it causes irritation of the periostium, it will pass off of itself.

If the pulp cannot be removed entire it must be thoroughly antisepted with a penetrating agent. For this purpose use either a solution of Zinc chloride (not oxychloride) which will penetrate the whole tract, or a preparation of Iodine- Iodine Iodoform or Iodal- which will vaporize and the vapor of which will penetrate the tissue and antisept it. Seal up and leave for a month or more.

In filling the roots of lower teeth when gravitation assists, put a drop of Zinc chloride solution in the pulp chamber; and with a firm probe work it down into the canals; Then introduce some of the powder and work it down also By this time the canal may be entirely filled.

The advantages of such a filling are:--

1. It becomes hard.
2. It penetrates the tubules.
3. It acts as an antiseptic.

If it passes through the apex, however, it sets up acute periostitis, which soon subsides of itself after which no further trouble need be anticipated from that root.

If the bottom of the canal can be reached with a broach, however, it is better to pack a small pledget of cotton at the apex.

## TEETH ALREADY DEVITALIZED.

In these cases there may be blind abscesses at the root.

1. Open freely into the cavity and pulp chamber; stir up the contents slightly with a probe and wash them out with warm water.
2. Dry carefully with small pieces of cotton, being careful not to force septic matter through the apicial opening.
3. Flood the whole tract with an creosote
   Hg, Cl2, 1-500 antiseptic
   1000
4. Thoroughly clean out the root canal.
5. Dry canal carefully with absolute alcohol, disinfect again and pack a long rope of cotton tightly into the canal, leaving the end projecting to be removed by the patient if it causes pain.
6. If no pain results in 4 or 5 days, the cotton may be removed and the root permanently filled.
7. If the stopping causes pain repeat the application and if with the same results, a passive abscess is indicated.

Campho-phenique valuable on account of its penetrating and volatile qualities.

## BLIND ABSCESSES.

In the treatment of a blind abscess, the entire tract may be disinfected. This may be done:--

1. By sealing up Iodine or one of its preparations, or

Campho-phenique in the pulp, so that its vapors will penetrate the entire tract.

2. By injecting an antiseptic agent forcibly through the apicial opening.
3. By sealing tightly and forcing a fistulous opening.

## ALVEOLAR ABSCESSES.

Alveolar abscesses are always due to devitalized teeth and the presence of septic matter. They may be made acute by:--

1. Closing of the cavity in the tooth.
2. Forcing septic matter through the apex.
3. Constitutional causes interfering with the excretory functions.
4. Excessive fatigue either physical or mental.

An abscess always begins with acute inflammation at the apex. The pain may be acute at first or may be merely a feeling of fulness. Following this there is an effusion from the bloodvessels which speedily degenerates into pus. This pus increasing in amount enlarges the cavity which contains it and progresses in the direction of the least resistance usually pointing upon the gum externally.

An alveolar abscess may run its course in 36 or 48 hours in a child but may take 4 or 5 days in aged persons the tissues being much more resistant.

After the pus has escaped a permanent fistulous opening is established the walls of which become mucous in character so that they will not heal together unless greatly irritated and stimulated.

## TREATMENT OF PERIOSTITIS.

Threatening to form an abscess.

If the tooth has been recently filled and the trouble is due to the confinement of morphite gases a free opening into the pulp chamber must be made. At the same time counter-irritants should be applied to the gum. In the earliest stages a little capsidum powder applied on the moistened tip of a finger makes an excellent remedy. At a later stage a saturated solution of Iodine in Flemming's Tincture of Aconite should be used.

An alveolar abscess always has for a predisposing cause a devitalized pulp. The exciting causes may be:--

1. Chemical irritation.
2. Mechanical violence.
3. Constitutional disturbance.

The last is by far the most frequent.

TREATMENT.

1. Continuous cold in the form of pounded ice wrapped in flannel and applied to the part while the inflammatory products are being thrown out, is a specific. Should be left 5 or 6 hours.
2. Counterirritation in the form of a saturated solotion of Iodine in Flemming's Tr. of Aconite.
3. Constitutional treatment in one of 4 directions:--

a. Arterial sedatives are aconite (Drop doses every half hour) to lessen the force of the circulation.
b. Local sedatives (aconite) to lessen the sensibility of the nerve filaments and thus relieve the incitement to congestion.
c. Hydragogue cathartics, diuretics or diaphoretics to lessen the fluid in the blood.
d. Quinine to constrict the capillaries 6 to 8 grs.

To relieve periostitis in the morning prescribe:--

1. Painting the gum with Iodine and Aconite.
2. 6 or 8 grs. of Quinine.
3. Rest and quietness.
4. Hydragogue cathartic.
   Mag. Sulph. iv. dr.
   Potass Bitart ii dr.

0 I Menthis Pipepate gtt ii

In the evening:--

1. Paint the gum with Aconite and Iodine.
2. Give Aconite (Tr) in 1 drop doses every 1/2 hour.
3. Give Diaphoretic and Diuretic.
   Dovers Powder Grs. x.
   Potass Nitrate grs. ii.
4. Instruct the patient to go to bed.

EFFECTS OF IODINE AND ACONITE.

Applied to the gum.

1. The Iodine stimulates the absorbents to absorb the inflammatory products thrown out.
2. Sets up superficial irritation and determination of blood to the surface.
3. The aconite acts as a sedative to the nerve filaments and gives relief from pain by partially paralyzing them.
4. The aconite, by partially paralyzing the nerve filaments, removes the incitement to the congestion.

If an abscess cannot be avoided hasten its formation and thus lessen the duration of the pain. Apply a poultice made from a piece of roasted fig with the flesh side against the gum. Do not poultice externally as the heat and moisture soften the tissues and may cause the abscess to point externally.

To heal up an abscess the entire tract must be thoroughly disinfected. For this purpose either drill an opening through the pulp chamber or place a wire in it and fill around with phosphate. Upon withdrawing the wire insert the point of a hypodermic syringe and force the fluid through the fistulous opening upon the gum. Use creosote for this purpose.

Permanent abscesses which will not yield to this treatment may be due to:--

1. Strumous diathesis.
2. Low vitality of the system.
3. Mechanical irritation due to the end of the root being eroded or else covered with a cerumal deposit.

In the first case it should be left to a physician.

In the second give tonics for a week or two.

In the third try injecting Aromatic Sulphuric Acid and if necessary extract and replant.

Odontalgia is frequently caused by devitalization of only a portion of the pulp. The gases that are formed escape partly by filtering through the enamel but if developed too rapidly they press upon the remainder of the pulp and cause pain.

In these cases treat by expanding the gases causes pain while cold relieves the pain by contracting them.

## DIAGNOSIS.

1. Suspect a wisdom tooth if the pain cannot be located.
2. If not in wisdom tooth suspect a tooth that has been filled.
3. If it is not complicated with periostitis and does not respond to percussion isolate it and throw a stream of hot water upon it.
4. Apply cold in the form of ice or cold water.

It is a well authenticated fact that a tooth may actually burst from the pressure of the gases within them.

**TREATMENT.** Relieve the pain by drilling into the pulp chamber at the point nearest the filling. This gives immediate relief.

## SENSITIVE DENTINE.

Dentine is endowed with the functions of:

1. Sensation.
2. Nutrition.
3. Absorption.

Sensitiveness of dentine is due to the protoplasmic prolongations of the odontoblasts which fill the tubules of the dentine. Irritation of these causes sensation to be transmitted to the odontoblasts which in turn transmit it to the nerve filaments lying in contact with them and from these it is transmitted to the brain.

Extreme sensitiveness of the dentine may be normal or pathological. As treatment may depend somewhat upon which of these conditions.is present, a diagnosis should be made.

1. In old patients hypersensitiveness is almost always pathological, in young patients normal.
2. If the teeth are always very susceptible to changes of temperature the condition is probably normal.
3. If the patient is living under a high pressure from excitement the condition is probably normal.

Sensitive dentine is caused by the same cause that sets the teeth "on edge"; namely, the irritation of an acid. The condition known as "teeth on edge",is caused by acids penetrating the enamel and irritating the periphery of the dentine processes.

Sensitive dentine may be either general or local.

If general it is due to a general acid condition of the system or of the fluids of the mouth. It may be corrected by giving Bicarbonate of potash in 10 gr.doses three or four times a day.

If local it will be found about the necks of the teeth being caused by the acid secretion of the gums. It may be relieved by applying an antacid paste made of Prepared chalk, baking soda or other antacid about the necks of the affected teeth.

Hypersensitive dentine in the normal condition is dependent on the temperment and tooth structure of the patient.

## TREATMENT OF PATHOLOGICAL SENSITIVE DENTINE.

Gently remove as much of the debris as possible without hurting the patient, neutralize any acid present by a drop of ammonia and fill with a zinc phosphate filling. After a few months the hypersensitiveness will have disappeared.

## TREATMENT OF NORMAL SENSITIVE DENTINE.

1. Gain the confidence of the patient.
2. Have the instruments sharp.
3. Use spoonshaped instruments with broad faces.
4. Apply rubber dam over the tooth.
5. Dry with absorbent cotton.
6. Apply absolute alcohol.
7. Remove the alcohol and dry with a hot air syringe.
8. Apply fine ether spray with a suitable apparatus.
9. Wipe out the cavity with carbolic acid to form an eschar and prevents the contents of the tubules being irritated by the filling.

## REMEDIES.

1. Absolute alcohol with warm air.

2. Robinson's Remedy ($C_6H_5OH - KOH$)
3. Zinc chloride (crystals) most successful.
4. Absolute alcohol. Dehydrated glycerine, and Tannic acid,-equal parts.

Absolute alcohol relieves the sensitiveness by abstracting water from the substance of the tubule contents causing it to shrink towards its fixed extremity at the pulp leaving part of the tubule empty and consequently void of sensibility.

Hot jet of Nitrous Oxide heated quite hot.

## IMPLANTATION.

Suggestions:--

1. In selecting a tooth for a space where the labial surface is badly absorbed away, select one with the crown at such an angle to the root as to throw the latter towards the lingual surface. A lower incisor or bicuspid answers the purpose very well for the upper jaw.
2. Give an anaesthetic unless contra indicated.
3. If gum is narrow make a straight incision in the line of the arch and cut out a semilunar piece of gum for the lingual side.
4. After trephining through the compact tissue drill up into the cancellous tissue to a sufficient depth and then cut and fit until the socket is adapted to the root.

   If the tooth fits tightly in the cancellous tissue so much the better, as it can then be easily forced to place and will be tight and firm.
5. Soak the tooth in a bichloride solution for several days.
6. Use absolute alcohol as a disinfectant for the instruments and socket. $HgCl_2$ may be used in the final disinfection.
7. Avoid having blood clots in the socket just before inserting the tooth.
8. Stay the tooth firmly after insertion.

## PROSTHETIC DENTISTRY.

Dental Prosthetics or Mechanical Dentistry teaches the art of replacing lost dental organs. It is divided into:--

1. Replacement of lost teeth.
2. Replacement of soft palate.
3. Replacement of lost alveolar tissue.

Any dental appliance should answer thre requirements; viz.:--

1. It should be useful in mastication.
2. It should assist distinct articulation.
3. It should be aesthetic and give a proper expression to the features.

In the preparation of the mouth for an artificial denture generally speaking all roots of teeth should be removed. To this there is an exception in the case of patients who have prominent upper jaws and short upper lips and show their teeth and gums whenever they smile. If the teeth and roots are removed in these cases the artificial character of the denture will be manifest at a glance. It is better then, if possible, to put the roots of the six anterior teeth in a healthy condition and fit the artificial teeth to them. Sometimes a tooth may be left if it is very useful for mastication.

In the case of patients who have scarcely any alveolar ridge left in the lower jaw, a root may be left to form an abutment for the plate.

General reasons for extraction:--

1. Roots prevent a perfect adaptation of the plate and the plate rests unequally on them and the adjacent tissues.
2. Nature has a tendency to exfoliate them and thus interfere with the future adaptation of the plate.
3. The pressure of the plate may so irritate them as to cause inflammation. Single roots of incisors or cuspids in one or both sides, if healthy, should be left as the tooth may then be replaced by a crown or in any case there will be less shrinking of the gum.

## EXTRACTION OF TEETH.

If the teeth have manifested a strong tendency to caries in early life, they should be extracted in preparing the mouth for an artificial denture. If, however, the patient has reached middle age with a number of teeth in good condition they should not be extracted. Between these extremes we must be guided by:--

1. The age of the patient. Wisdom teeth should be in place.
2. The care of the teeth that is taken.
3. Family predisposition.
4. Any other circumstances and conditions.

In no case should all the teeth of either jaw be removed before the patient is 20 years of age and not then unless the wisdom teeth have been erupted.

In the mouths of patients of middle age, and upwards the cuspids alone are often found in the mouth. These should almost always be extracted.

1. Because as a rule they are out of their natural position and therefore spoil the aesthetic effect of the denture.
2. Because if left they will invariably form the initial points for a fracture of the base.

Should they be in their proper position, however, the natural appearance of the face could be better preserved by leaving them, and the patients should have the advantages and disadvantages pointed out and then allowed to choose between them.

In patients of middle age if we have a bicuspid or molar on one side or on both sides which occludes with teeth below and can be put into a healthy condition they should be left in the mouth. In the case of 1st. bicuspids, however, the danger of fracturing the plate while less than if a cuspid is left, is yet sufficient to make it worth mentioning to the patient.

In elderly patients, if one or more teeth remain on each side invariably leave them if they can only render even temporary assistance in keeping the plate in place.

In the lower jaw it is rarely desirable to extract a sound tooth.

When the crown of an incisor has been lost, if the root can be made healthy it should be retained and the tooth replaced by a crown, or if a plate is desired the tooth should be ground to fit the root.

It should be remembered that when a partial denture has been inserted into the mouth, the danger of caries in the remaining teeth has been increased. For partial plates metallic base is preferable to vulcantite as the surfaces lying against the teeth are much smaller. To guard against these evils partial dentures should never be worn at night and after meals the mouth should be thoroughly rinsed with water.

All deposits of calcarious matter should be removed from the teeth. Tartar is a deposit from the saliva composed of lime salts glued together with broken down epithelial matter of the mouth.

Its composition is:--

| | | |
|---|---|---|
| Phosphate of lime | 60 | parts |
| Carbonate of lime | 15 | " |
| Mucous and animal matter | 15 | " |
| Water | 10 | " |
| | 100 | " |

It is deposited from the saliva of all the glands and its hardness seems to depend on the slowness with which it is formed. It is found most adundantly near the openings of the glands from which it spreads laterally. It must be removed with scalers made either to act with a push or a draw cut. Chisels or those acting with a push are preferable:--

1. Because they cut to the lowest limit of the deposit.
2. Because the cutting of the alveolar border by them sets up healthy inflammation and leads to the reformation of a certain amount of tissue.

After all the tartar has been removed with scalers there still remains a roughness which may be removed by friction or solution or both. For purposes of solution a pledget of cotton dipped in aromatic Sulphuric acid may be applied to the parts and will dissolve away the small particles.

The advantages of Aromatic Sulphuric Acid for this purpose are:--

1. It leaves a smooth surface.
2. It destroys parasites or germs.
3. Sets up healthy inflammation.
4. It acts as an astringent.

Tartar is deposited from the saliva when the fluids of the mouth from any cause have been alkaline. Ordinarily the fluids of the mouth are neutral. The saliva is slightly alkaline and these neutralize each other. If the fluids are markedly acid no tartar is deposited as the acid dissolves it: If on the contrary the fluids are markedly alkaline the saliva is unable to hold the lime salts and they are deposited as tartar. As caries is largely due to the action of acids the depositing of tartar is not usually accompanied by a tendency to caries.

The alkalinity which causes the deposit of tartar is usually due to the presence of ammonia.

All teeth left in the jaw should be put in a healthy condition, if the patient will submit.

Stains and discolorations should be removed from the anterior teeth before inserting a partial denture.

The mucous membrane of the mouth should be made healthy. The removal of diseased teeth, roots, tartar, &c., usually effects this unless the diseased membrane is the result of wearing a previous denture.

The diseased membrane found after wearing a plate may be due to:--

1. Want of cleanliness.
2. Want of good adaptation.
3. Non-conducting properties of base.
4. Improperly constructed air-chamber.

Dr. Black, of Chicago, attributes this condition to the presence of micro-organisms, and that these germs result from a lack of cleanliness. He contends that the plates should not only be brushed, but be washed with a germicide, as well.

In the treatment of the inflammation of the membrane known as rubber sore mouth, the patient should be directed to go without the plate for a few weeks or more. If the patient will not submit to this the mouth and the plate should be kept thoroughly clean with a germicide, such as carbolic acid (1 in 500) and if the parts are swollen an astringent mouth wash may be used.

## EXTRACTION OF TEETH.

Position of patients:-- A very good position is to have the patient seated in an ordinary chair, the operator placing the left foot on a chair behind the patient and holding the head on his knee. In a dental chair the operator should lower the chair and stand over the patient in extracting lower teeth and should raise the chair and tilt it back in the case of upper teeth.

Selection of forceps:-- Three general points should be observed:--

1. The beaks should be adapted to the necks of the teeth to be extracted and should embrace as much of the neck as possible.
2. The beaks should be at such an angle to the handle that when applied to the neck of the tooth the handle will be thrown out of the mouth.
3. The handles should be stiff and rigid so as not to spring.
4. Handles should have no hooks on them.

Preparatory to the extraction of teeth (not roots) lancing, as a rule, inflicts unnecessary pain and is not desirable. It is objectionable on account of:--

a. The pain.
b. The increased hemorrhage it causes.
c. The extra courage necessary on the part of the patient

In the extraction of a number of teeth, say under an anaesthetic, it is best to begin at the least accessible part and work from behind forwards, so that the bleeding will not interfere. The anterior teeth may be left for the last. For the same reason it is advisable to extract first from the lower jaw. As a precautionary measure a loose sponge may be placed in the back of the mouth to prevent the swallowing of blood.

## SUPERIOR THIRD MOLARS.

These are ordinarily easy to extract. The roots, however, may curve backwards or outwards, in which case the grinding surface will incline in the same direction. In these cases luxating directly outwards; or prying them out with elevating forceps will remove them. In ordinary cases they are best removed with bayonet forceps.

## SECOND SUPERIOR MOLARS.

These are removed by luxating first outwards and then inwards, and offer considerable resistance on account of the divergence of their roots. If molars are slightly rotated after luxation, they may be removed more nicely by the enlargement of the socket.

## FIRST MOLARS.

These offer usually even more resistance than the 2nd Molars, and are extracted in the same way.

## SECOND BICUSPIDS.

These do not offer serious resistance usually although about 1 in 20 has a bifurcated root.

## FIRST BICUSPIDS.

These have oval roots about 6 out of 10 of which are bifurcated, making them very difficult to extract. They should be grasped as high up as possible and luxated outwards and then inwards very gently. (Arm luxation).

## CUSPIDS.

These have long conical roots firmly attached to their sockets and can be extracted by rotation and traction. Rotation is facilitated by first extracting the teeth on either side, so that the lateral support of the socket is removed. The tooth may then be grasped if necessary at the sides adjacent to the extracted teeth.

## LATERAL INCISORS.

These have oval roots which are long and slender and frequently curved near the apex. These teeth are very liable to break and should be grasped high up on the neck and luxated gently. The alveolar is thich on account of its proximity to the canine and is not very liable to be broken.

## CENTRAL INCISORS.

These are easily removed by rotation and traction. Should not be luxated for fear of breaking the alveolars.

## LOWER TEETH. Incisors.

These offer very little resistance to extraction which is performed by luxating them slightly and applying a traction force.

## CUSPIDS.

These usually have a long straight firmly fixed root. They may be luxated, and if the adjoining teeth are removed they may be grasped by the sides and rotated.

## BICUSPIDS.

These are easily removed by rotation.

## FIRST MOLARS.

Above all others these resist extraction. They must be grasped firmly and luxated first outwards and then inwards. They must not be luxated first inwards as that would be keying the arch. Their roots sometimes curve backwards.

## SECOND MOLARS.

These have usually less divergence of the roots and are extracted in the same manner as the 1st Molars, but with less force.

## THIRD MOLARS.

These frequently have their roots curved either backwards or outwards.

In the case of lower 3rd Molars luxate first inwards. There is less resistance internally, and as there are no teeth behind them this inward luxation does not "key" the arch.

## EXTRACTION OF ROOTS.

If a root does not project sufficiently far to be grasped by the forceps the gum should be freely lanced. An incision should be first made through the gum in a vertical direction to the aveolus covering the root. The corners of the gum should then be directed back by loosening the flap on each side by a single cut. The alveolar forceps should now be applied so as to grasp the alveolar wall over the root and secure a firm hold. As the closing force is applied the forceps should be rotated slightly with a wriggling movement so as to cut through the alveolus, when the root may be firmly grasped and removed by rotation, luxation, or simple traction. In extracting the roots of lower molars the distal root had best be extracted first, as it comes the more easily.

In general where a number of roots are to be extracted those most deeply imbedded should be taken out first to avoid their being hidden by the blood.

If a lower wisdom tooth has been broken off deep down the sace is almost hopeless.

Alveolar forceps should not be used to extract the roots of the six anterior teeth. If they cannot be grasped by another forcep use the screw.

## ELEVATORS.

Elevators are of four kinds:--

1. Screw elevators.
2. Hook "
3. Push "
4. Right Angle Elevators.

1. Screw elevators should have the screw not blunt, but long and tapering with a sharp clean thread. A tap should be filed transversely across the thread. In applying the screw it should be given a half turn to the right and then a quarter turn to the left continuing this until a firm hold is obtained. Previous to the introduction of the screw the cavity should be drilled out until its walls are sound and hard. If the root is loose it may be removed by applying the thumb to the adjoining tooth and exerting gentle traction. A better way, however, is to apply a pad of cotton to the adjoining tooth and grasping the elevator with the beaks of a pair of forceps, lift the tooth out by using the solid tooth as a fulcrum. Sometimes, however, it is necessary to luxate. If the screw slips the first time apply again.
2. Hook elevators are used where a root has one surface extending up much farther than the other. The elevator is usually worked across the mouth.
3. Push elevators are shoved down along the tooth or root, and then the handle is depressed until it is a little lower than the part against the tooth, when a pushing force is applied upwards and inwards.
4. Right angled elevators are applied in a somewhat similar manner, the teeth being lifted out by rotating the hand.
5. Another style of elevator is pointed and has one side rounded, while the other is flat. In taking out, say, a first bicuspid root, the point is forced between the cuspid and root (the gum being lanced of course) with the rounded side next the cuspid. By simple rotation the root can be lifted up. Always guard the point of the elevator with the thumb of the opposite hand wrapped in cotton.

## MECHANICAL HINDRANCES.

1. In lower molars the apices of the roots may approach each other so as to inclose a portion of the alveolus of a somewhat wedge shape. If this cannot be sufficiently compressed to permit extraction an attempt may be made to rotate the tooth

tooth and break off this portion of the alveolus. A similar condition is sometimes found in connection with the buccal roots of upper molars.

2. Backward or Outward curvature of 3rd Molar roots, either above or below.
3. Exostosis of Root. This is most liable to occur in connection with bicuspids. It is indicated when teeth have been loosened and can be moved a little up and down but cannot be removed. If the exostosis is very large it cannot be removed without cutting down the alveolus. If a broken root is in this condition it will not exfoliate but is liable to become the seat of a chronic abscess. Whenever, then, we find an abscess high up in the jaw, with the gum healed over below, it is pretty certain that we have an exostosis root. They can only be removed by cutting.
4. Another mechanical hindrance is where a crown has been partly or wholly lost, and the adjoining teeth have approached each other leaving only a narrow space between them. In these cases force the tooth either outwards or inwards until it will slide past the corners of the adjoining teeth.
5. Osseous union between two teeth. This is rare and may be due to:--

1. Coalescence of the tooth germs.
2. Union of two exostosed roots.

## POSITION UNDER ANAESTHETIC.

Under Chloroform the patient should lie perfectly recumbent, so that the blood may easily flow to the brain. Lower teeth may then be extracted by standing behind the patient and using bayonet forceps.

The same is true of Ether, but the recumbent position is not quite so necessary.

Under Nitrous Oxide, the patient should sit upright with the head slightly thrown forwards. In this position breathing is quite free, and the danger of a tooth falling into the larynx is minimized.

Never have the patient in the half recumbent position.

## ACCIDENTS OF EXTRACTION.

1. Breaking of the tooth.
2. Splintering of the alveolar wall.
3. Removal of two teeth instead of one.
4. Striking of the forceps against the teeth of the opposite jaw so as to fracture them.
5. Allowing an elevator to slip and injure some of the soft tissues.
6. Tearing the gum. Especially liable to occur in the case of wisdom teeth standing alone. In these cases the lancet may be used.
7. Allowing a tooth to fall into the pharynx.
8. Allowing a tooth to fall into the larynx.
9. Dislocation of the lower jaw.
10. Excessive hemorrhage.

Most of these accidents can be avoided by observing the simple rule never to apply more force in extraction than is necessary to move the tooth.

An elevator should be guarded by the thumb wrapped in a napkin. If a tooth falls into the pharynx and is swallowed, as a rule no evil effects need be feared.

If a tooth falls into the larynx an expert should be called in if within reach; if not, an intelligent physician should be sent for. By the use of the laryngescope and long forceps a tooth can often be safely extracted. A mouth-mirror will often show the position of the tooth. If the tooth has lodged in the larynx it will cause coughing. A violent blow on the back may dislodge it, or failing this, severe coughing or sneezing should be induced.

Dislocation of the jaw may be caused by downward pressure and luxation applied to a tooth of the lower jaw.

Luxation differs from dislocation in the fact of its being partial only, the condyle not having slipped beyond the eminence; but merely resting upon it.

## INDICATIONS FOR EXTRACTION.

1. Painful teeth which cannot be restored to usefulness.
2. Wisdom teeth which are affected with periostitis or which threaten to form an abscess. It is rarely desirable to devitalize a wisdom tooth.
3. Badly decayed teeth which if extracted may be replaced by others not yet erupted. In a child 9 or 10 years old if two or three of the 1st Molars are badly decayed, extract the four. On the same principle a 2nd Molar may be extracted and replaced by the 3rd Molars. Only the single diseased tooth

need be extracted in this case, however.

4. Teeth which are the seat of incurable abscesses.
5. Teeth the roots of which cause antrum trouble.
6. Wisdom teeth which are crowded and cause persistent neuralgia.
7. Loose teeth which cannot be restored to usefulness.
8. Where it is necessary to extract for judicial regulation.
9. Teeth which are to be replaced by permanent ones.
10. Teeth erupted in abnormal positions which cannot be brought into proper position.
11. Roots of teeth causing unhealthy gums or secreting offensive matter.
12. Where the patient cannot or will not afford better treatment.

## HEMORRHAGE.

Bleeding from extraction usually ceases, in from 3 to 5 minutes.

Nature arrests it in 3 ways:--

1. The end of the vessel contracts.
2. The vessel is retracted into the tissue.
3. The blood in the mouth of the vessel coagulates as far back as the first anastomosis.

The patient should place his head over the cuspidor, so as to allow the blood to flow freely from the mouth. Sucking spitting and washing out the mouth prolong the hemorrhage.

Excessive hemorrhage may arise from:--

1. An abnormally large artery.
2. Excessive tearing or wounding of the soft parts.
3. Inflammation of the parts.
4. Hemorrhage Diathesis.

If from an abnormally large artery the blood will be a bright red the flow will be somewhat pulsating, and the bleeding will be excessive in both quantity and duration.

If from excessive tearing of the soft parts the bleeding will be excessive in quantity and not duration.

If from a hemorrhage diathesis it may not be excessive in quantity but will be of very great duration.

Excessive bleeding from an artery may sometimes be stopped by passing a small bur down to the apex of the socket, and giving it a half twist so as to produce tortion of the artery. If, however, the artery has been rupted a little above the apex this is impracticable and then the socket may be plugged with a roll of cotton long enough to project from the cavity after it has been firmly packed with a straight instrument. The end projecting is then impacted in a solid mass over the gum and pressure applied by a cork or otherwise. This should be left in position three or four hours.

By hemorrhage Diathesis is meant a condition of the system, in which there is a defect in either the quantity or quality of the fibrin or both in the blood, and a want of contractile power in the vessels.

In such cases styptics together with mechanical pressure must be employed.

A long rope of cotton dipped in a saturated hot solution of alum may be packed in the cavity, and pressyre applied by the outside teeth. If this will stop the bleeding it will do so at once. It may be tried several times, and if unsuccessful a solution of perchloride of iron may be used. This failing, difital pressure must be employed on the cotton pad, and should be kept up for about an hour. A saliva ejector should be used so there will be no necessity for spitting or swallowing.

In severe cases of hemorrhage administer internally;

Opium 1 grain.
Acetate of Lead- 2 or 3 grains; in from 2 to 4 hours.
Lessen the force of circulation,
Or
15 to 20 drops of Perchloride of Iron.
Or
Ergot.

In all cases of hemorrhage, perfect mental and physical quiescence must be insisted upon.

A hemorrhagic diathesis is found in full fleshed persons, having soft muscles and a pale pasty-looking face.

## ARTIFICIAL DENTURES.

If a provisional denture is to be worn it should be inserted immediately after extraction. This is especially true of partial dentures where neck teeth may be used. There is no objection on account of soreness, as gums heal more readily under a denture than without one. A provisional denture with "neck" teeth should be worn constantly for three or four days to maintain the socket for the neck of the tooth.

A provisional denture preserves the expression of the features, which, if once lost, can never again be restored.

Provisional dentures should be worn for 8 to 10 months, but never more than a year.

The evil results of wearing a provisional denture too long are:--

1. The occlusion becoming imperfect the strain on the alveolar process is unequal and the process becomes softened and absorbed at certain points, leaving a cartilaginous ridge.
2. The muscles fall in above the denture and spoil the expression of the face.
3. Owing to the absorption of the alveolus the plate will not fit.

After extraction if the gums are not much torn use Tincture of Calendula, either pure or diluted.

If unpleasant decompositions are going on use:--

1. Borax and water.
2. Carbolic acid and water.
3. Weak solution of permanganate of potash (s few drops in a glass of water).

Loose fragments of gum should be clipped off.

## IMPRESSIONS.

The first requisite is a suitable tray or impression cup. Best are made of Britannia metal. The requisites of a cup are:--

1. Rigidity.
2. Approximation to the form of the arch and ridge.
3. Form which will admit of easy introduction into the mouth.
4. Cleanliness and smoothness.

For full dentures use and oval cup.

For partial dentures use a cup with square outer edges, because:--

1. The molar teeth will fit such a cup more closely.
2. The material is not so likely to be pulled out of the cup.

For high arches a special cup of impression compound may be made, or an ordinary cup may be built up with wax.

Always use as small amount of impression material as possible.

An ideal impression material should be:--

1. Sufficiently plastic as to be easily adapted to the surfaces without much pressure.
2. A substance that will take sharp impressions of fine lines.
3. A substance that passes promptly from the plastic to the rigid condition.
4. A substance that does not appreciably change its form

in passing from the plastic to the rigid condition.

5. A substance that is plastic at a temperature bearable in the mouth. 130°.
6. A substance that is not offensive to sight, taste or smell.

## BEESWAX.

When pure is a light yellow color, breaks clean,- is not greasy,- melts at 140° and softens at 110° to 120°.

When softened it is somewhat tough and plastic, and takes a fair impression. It is frequently adulterated with tallow and starch.

This is indicated by:--

1. Greasy feeling, if rubbed.
2. Does not break clean.
3. Can be tasted.
4. Melts below 140°.

It is sometimes adulterated with starch. This may be detected by boiling in water and adding an iodine solution when it turns blue if starch be present.

For taking impressions it is broken up, placed in warm water (120° to 130°) allowed to soften undisturbed, and then worked into a soft mass. Color should be dark yellow.

## OBJECTIONS.

1. Requires too much pressure.
2. Passes slowly from plastic to rigid condition.
3. Does not take sharp impression of fine lines.
4. Drags in taking an impression of an undercut.

White wax is prepared by bleaching thin cakes of yellow wax in the sun and in the presence of moisture. It melts in a higher temperature and is not quite so plastic. It is harder, however, and passes more promptly to the rigid condition.

## GUTTA PERCHA.

This is the product of the Gutta Percha tree of the East Indies. The trees are cut down and the mucilaginous substance scraped from the outer surface of the wood and inner surface of the bark. This is evaporated to hardness, ground into a pulp, washed and pressed into a solid mass. Its natural color is gray but it may be bleached white. It is insoluble in water but readily soluble in chloroform and the fixed oils. It becomes very plastic at 160° when heated, and takes very sharp impressions- better than any other material.

It softens at a temperature which cannot be borne in the mouth and must be cooled to 140°, then inserted into the mouth.

OBJECTIONS.

1. Danger of burning the mouth.
2. Changes form in passing from plastic to rigid condition.

A layer or thin sheet of Gutta Percha is sometimes placed over a plaster impression and replaced in the mouth. Almost accurate impression may be taken in this manner.

PARAFFINE.

Paraffine is a hard white wax-like substance, which is one of the products of coal tar. It has all the disadvantages of white wax. It improves beeswax to add a small amount of paraffine as it softens at a lower temperature and becomes more plastic. Melts 110°- 130°.

Impression Compound:--

This is composed of

[illegible]
Carmine
[illegible]
[illegible]

1. Paraffine
2. Gutta Percha
3. Beeswax
4. Canada Balsam
5. Carmine or other coloring

It combines the good qualities of the other materials.

One objection is that it has a tendency to change its form while plastic. This is due to its elasticity, and may be overcome by pressing and holding it firmly against the parts until quite hard. Heated to about a temperature of 140° until quite plastic.

PLASTER OF PARIS.

Plaster of Paris (Ca S.O.4) is prepared from gypsum (Ca S.O.4 x 2 H2 O) by heating the gypsum moderately and and thus driving off most but not all of the water of crystallization. The gypsum is first broken up and pulverized and then the heat applied. When it has reached a temperature slightly above the boiling point of water it begins to boil and does so until the water is driven off. The temperature should not be raised above 260° .

Plaster of Paris should either be freshly prepared or else kept excluded from the atmosphere. If exposed, however, the moisture only penetrates a very short distance.

The finer grades are the most convenient as they harden more promptly. The coarse plaster, however, becomes the hardest.

PREPARATION OF THE MOUTH.

The mouth should be cool and free from mucous. It should be rinsed thoroughly with cold water just before taking the impression. If the parts are congested an astringent may be added to the water.

PREPARATION OF MATERIAL.

Beeswax should be softened in water in which the hand can be borne. It should be left undisturbed until soft and then worked into a soft plastic mass.

Impression Compound should be softened in water a little below the boiling point. It should also be left undisturbed until soft, and then removed and worked until it it dry and sticky. It should then be moulded in the cup to fit the surface of the parts to be taken, and then passed over a spirit lamp so as to form a glassy surface. This forms a layer which will take a very sharp impression of fine lines.

Plaster of Paris:--Add to the water about half as much common salt, or (preferably) sulphate of potash as will lie on a five-cent piece. The water should be 60° and the salt should be dissolved. Then add the plaster slowly, allowing it to settle until a little appears above the surface of the water. Then beat rapidly with a spatula until it can be piled up, when it should be at once introduced into the cup and mouth.

Sulphate of potash is better than salt, as it prevents the expansion of the plaster.

Lime water will make the plaster harder.

Alum reduces the expansion and increases the hardness.

Plaster of Paris is used:--

1. In most full upper dentures.
2. In partial cases where it is necessary to obtain an accurate impression of undercuts formed by overhanging teeth.
3. Where there is a marked variation in the density of the gum in different parts of the mouth.

Impression Compound is used:--

1. In nearly all full lower dentures.
2. Ordinary partial cases.
3. In dovetailed spaces: if the compound is removed at the proper time it will return to its original shape.

It is more comfortable to the patient, and in the case of lower dentures has the advantage of keeping the cheek away better than plaster.

In taking an impression on Compound it must not be slid along the mouth from before backward as is done with plaster. That would blur the impression.

1. Use no more material than is necessary.
2. Mould the material so as to approximate the shape of the mouth.
3. Immediately before introducing hold it over an alcohol flame to soften its surface. It will then take sharper impressions of fine lines than plaster.
4. Hold the impression material rigidly against the parts.
5. Introduce into the mouth and pass horizontally backwards until directly under the parts to be taken, and then press directly upward.

In using Plaster of Paris have the patient sitting erect with the head thrown forward. In order to avoid inclosing an air bubble elevate the cup, first in front, so as to force tha air out behind. Then raise vertically to place. Avoid:--

1. Enclosing air.
2. Blurring by sliding.

To avoid gagging:--

1. Use no more material than necessary.
2. Have the patient breathe through the mouth.
3. Paint with Solution of Potass-- Bromide if necessary-- or 5% Sol. of cocoaine.

In taking impressions of the lower jaw the head should be thrown forward and the operator should stand slightly behind the patient.

If the impression adheres to the mouth do not force it too much, but manipulate it so as to admit the air, which will assist it loosening the impression.

## PLASTER MODELS.

In obtaining a model from an impression in Compound, moisten the surface with water and pour the plaster on the highest part and jarring it down until it fills all the spaces.

If the impression is in plaster, varnish it with shellac varnish so that the pores are all closed up. One coat is sufficient. Apply soapsuds to this with a camel's hair brush pencil and pour as before.

The plaster cast should be made as soon as possible. In removing the compound immerse it in water considerably below the boiling point. Boiling water will make it adhere to the plaster. To make the cast hard, beat the plaster well.

## MANUFACTURE OF TEETH.

Teeth are made of porcelain which is composed of:--

1. Silex- Oxide of Si. (flint, fine sharp sand, quartz) Rock crystals.
2. Feldspar (Silicate of Alumina and Potash).
3. Kaolin or porcelain clay (disintegrated spar) Mixture of Silica 3 & Silicate of Alumina 8.

The silex and kaolin are infusible, but the Feldspar are carefully selected and heated strongly, after which they are plunged into cold water to make them friable. After this they are ground to an impalpable powder.

The Kaolin occurs as a white, dense, opaque, impalpable,putty-like mass. It is purified by diffusing it in water, when the heavier particles sink to the bottom. The milky fluid is then poured off and the pure Kaolin allowed to settle. Kaolin hardens on heating and shrinks considerably.

The body and enamel are mixed separately. The body is colored yellow by Titanium. Oxide.

The other coloring materials are Platina Sponge, Oxide of Gold, Oxide of Manganese, Oxide of Cobalt and Oxide of Uranium.

An English tooth is a homogeneous mass. An American tooth consists of a body and an enamel. An American tooth is somewhat translucent. An English tooth is stronger and may be cut and repolished, while an American tooth cannot be repolished if once cut.

Silex (Quartz, Silica, Silicic Acid) is an oxide of Silicon (Si.O2). In its purest form it constitutes rocky crystal. Silex is very widely diffused and constitutes 50% of all rocks.

Feldspar is a silicate of alumina (not aluminum) and potash with a little lime. The lime makes it more fusible. The Sapphire is the purest form of alumina (Oxide of aluminum).

Kaolin is a silicate of alumina prepared by nature. It is Feldspar deprived of the silicate of potash. As it is the silicate of potash which gives fusibility to spar, Kaolin is infusible.

Titanium Oxide gives yellow color.
Platina Sponge " gray blue "
Gold Oxide " red green "
Manganese " " purplish "
Cobalt " " blue "
Uranium " " greenish yellow

Dental porcelain contains more silex and feldspar and less Kaolin than chinaware.

The materials with the coloring matters are ground together into a putty-like mass.

The moulds are made of brass and are in two pieces. They are made about 1/5 larger than the tooth is designed to be to allow for shrinkage.

The moulds having been greased the pins are inserted. The best pins are the S.S.W. foot pins, the point or toe of which runs upwards into the thick part of the tooth.

The enamels are now placed in the moulds, the neck, point and body being put in separately after which the top of the mould is put on and the whole pressed. After this the moulds are dried and the teeth removed and carefully trimmed, after which they are sent to the furnace. Here they are gradually heated and finally exposed to an incandescent heat for 3 or 4 minutes, after which they are gradually cooled in an annealing oven, after which they are placed on cards for sale.

Porcelain teeth should possess:--

1. Naturalness.
2. Proper shape.
3. Strength.
4. Adaptability.

## SELECTION OF TEETH.

The best should always be used. Cheap teeth are deficient in size of pins, style and finish.

The White and Justi are the best American teeth. Of these the White are the stronger, but the Justi have a more artistic appearance.

The teeth should harmonize with the patient in color, size and shape. The tendency is to get them too small and too light in color. Teeth look larger and lighter in the hand than when moist in the mouth.

As regards size, if the six lower Ant. teeth are in position the uppers should be of such a size that the point of the cuspid will come between the inferior cuspid and bicuspid.

| | |
|---|---|
| For strength | Johnston & Lund's. |
| For appearance | Justi's. |
| For strength and appearance | White's. |

In regard to color:-

A dark brunette requires dark teeth.
A sallow complexion " yellow "
A bright & rosy " " light. "
Tall people with narrow faces require long narrow teeth.

Short people with short broad faces require short broad teeth.

If the mouth is wide arrange the teeth squarely in front. If the mouth is narrow have the arch formed by the teeth somewhat pointed in front, &c., &c.

## PORCELAIN DENTURES.

Porcelain dentures with carved teeth may be made as follows:-- An impression is taken and a cast made. This cast is sawed into two halves and these separated one sixth of their width. The halves are then sawed through and separated 1/6 in the other direction. The spaces are then filled in with plaster. The ridge is alos built up in about the same proportion. To this the tooth body is moulded about 1/8 of an inch thick. The outer surface is carved to form the teeth. After removal it is biscuited (slightly baked) to harden it, after which it is trimmed and the enamel is laid on. After which it is placed in the furnace and baked into a solid porcelain mass. Another cast of the mouth having been made it is covered with oil and rouge, and by frequent trials and grinding the plate is made to fit it. Such plates adhere well and are very comfortable, but are exceedingly liable to fracture.

## RETENTION OF DENTURES.

Dentures may be retained in place by:--

1. Springs.
2. Atmospheric pressure.
3. Clasps.

Springs are not much used in this country. Atmospheric pressure is best secured by means of an air chamber. An air chamber is a device by which we seek to obtain part of the theoretical air pressure of 15 lbs. to the sq. in. over a limited area. If the edges of the air chamber are sharp, and the adaptation perfect along the margins, a closed cavity is formed; and if half of the air is exhausted from this cavity, there will be a pressure over the air chamber of 7-1/2 lbs. to the sq. inch.

The advantages of an air chamber are:--

1. An increased pressure over the area of the space.
2. The entire denture is pressed firmly against the tissues so that adhesion is more perfect.

A good air chamber should have:--

1. Uniform and proper thickness.
2. Proper location.
3. Proper shape.
4. Sharp edges perfectly adapted to the mouth.

The thickness should be about 1/32 of an inch, and uniform. Whites are the best as they are not too thick.

The air chamber should be placed over the horizontal part of the plate. If placed in the vertical portion the pressure of the air is directed so as to slide the denture downwards along the inclined plane. For this reason partial plates should extend back over the horizontal portion.

The shape should be as nearly as possible circular This may be changed to an elongated oval, if desirable; from the shape of the mouth.

The edges should be sharp so as to make a perfect adaptation around the margins. This may be improved by running a bead around it by the use of a pointed instrument on the plaster cast. If an air chamber has rounded edges and leaks it is practically useless.

As the distal edge of the chamber rests against the tissues most firmly (on account of the hardness of the tissues there) the bead may be polished off at the point.

Heart shaped air chambers, or those having sharp angles, should never be used.

A plate should not extend backwards within 1/8 of an inch of the hard palate; nor the air chamber within 3/16 of an inch of the edge of plate.

If a plate apparently fits the mouth, but drops when the patient opens the mouth, either:--

1. The plate extends back too far; or,
2. The edges are too high.

In either case dressing off the parts will remedy the difficulty.

Deep spaces behind the alveolar process should be filled up with vulcanite.

Where a temporary denture is worn too long,-especially if mastication is performed with the anterior teeth,-the bony process becomes absorbed, leaving a soft cartilaginous mass. This may be avoided by inserting posterior teeth.

The average duration of artificial teeth, not needing any repairs, &c., is about two years. (Philadelphia).

## TRIAL PLATES.

Good trial plates may be made by rolling out Impression Compound and moulding it on the cast, strengthening it if necessary by a strip of tin bent to the proper form.

## BITE.

The best way is to place the trial plate in the mouth with a softened rim of wax over the alveolar border into which the patient is directed to bite.

In taking a bite for a double set the trial plates are placed in position and the wax rims trimmed ubtil they touch uniformly, after which they are either melted together, or else marked by cuts across the line of contact.

Another method is to take the bite in wax. Then cut transversely across and trim the parts. By placing these in the mouth in position the accurate bite can be ascertained.

A correct bite can usually be obtained by having the patient close the mouth, swallow and keep the teeth closed. If the patient can swallow easily with the plate in position, the occlusion is perfect.

## ARRANGEMENT OF TEETH:--

In arranging the teeth avoid the horse-shoe form. Four straight lines should practically bound the teeth: the first from the median line to the cuspid; the second from the cuspid to the second molar.

To have the teeth look natural:--

1. Don't have them too white.
2. " " " " small.
3. Have the cuspids prominent so as to hide the bicuspids
4. Avoid the bulldog expression which is caused by having the teeth incline downwards at the side.

5. Have the teeth of such a length that the lips will easily come together when the lips are closed. A line from the opening of the ear to the cutting edge of the cutting incisors should rest on the grinding surface of the first molar.

The six anterior superior teeth should never touch the lower ones when the mouth is closed naturally, as in swallowing. About 1/32 of an inch should be left between them. If the teeth occlude in front the plate will be thrown down behind The heaviest pressure or centre of mastication of an artificial denture should be at the 2nd bicuspids and 1st molars. The first bicuspid may touch slightly and the 2nd molar very slightly, if at all.

## GUM SECTIONS.

In grinding gum sections always grind from the labial to the lingual surface to avoid chipping. The grinding may be done on a wide, finely grained, perfectly true stone or on a very narrow one. In the latter case the section is slid from side to side to grind it evenly.

Have the points vertical. Joint the edges squarely.

If a thin edge is left by grinding out a V. shaped space these thin edges will chip by contraction of rubber. A very slight space may be left behind and filled in with phosphate or pink rubber if desired.

To avoid spreading joints:-

1. Make a square closely fitting joint.
2. Scrupulously avoid getting wax on the edges of the sections.
3. Before flasking soak the case in water. Plaster of Paris will then fill any little spaces.
4. Avoid drying and shrinking of plaster. Pack as soon as the plaster is thoroughly hard.
5. Do not use much access of rubber as the extra pressure forces the sections apart.
6. Fill any spaces between the joints with oxyphosphate, or pink rubber.

Two joints should be considered in inserting a provisional denture. Make contract that the first denture is worth $15.00 and the permanent denture $10.00 if the patient returns within one year.- $25.00 two sets. Do you [illegible]

To avoid breaking Gum Sections:-- this is [illegible]

1. Do not build wax over the upper edge of the sections as the shrinkage of the rubber will check the teeth. Have the upper edge square or beveled outward and build only flush with it.
2. Never allow the plaster in the lower part of the flask to impinge upon the section. Of choice it should not even cover the wax. This gives the section a solid backing and prevents breaking in packing and screwing together.

In flasking plain teeth have the plaster come up to the cutting edge of the teeth.

In waxing up do not use an excess, but represent the plate as nearly as possible. A rubber plate like a flat bone has two plates of compact tissue with cancellous tissue between. If much of this hardened surface is dressed off in finishing it is weakened.

Before inserting soak the cast in water. In mixing the plaster for investment add a little K2 S.0.4 to the water. Mix rather thin and beat thoroughly for some time so as to temper the plaster. It then becomes very hard.

To facilitate separation use soap suds.

Before separating warm the flask in hot water, taking care not to melt the wax. Wash out the wax from around the pins, &c., with boiling water. If wax is melted in the surface of the plaster and absorbed the rubber will not harden in contact with it.

If it is desired to veneer the plate with pink rubber, have the plaster in the lower part of the flask at the exact line which is to bound the pink rubber.

In packing take a strip of red rubber and pack it along the pins so as to cover them. Then place a V. shaped piece of pink rubber between the necks of each two teeth. Then pack red rubber to a line nearly level with the ends of the teeth, and to this red rubber fasten a rather broad strip of pinko extend upwards to the surface of the plaster which is to limit the pink. This may be strengthened by another strip along the ends of the teeth, when it is liable to be cut away in finishing. Fill in the rest of the space and the depression in the other half of the flask with red rubber.

In packing, warm the flask slightly and heat the rubber over steam.

Place the flask in boiling water, and after a few minutes, press.

To insure best results:--

1. Have no wax between the joints or anywhere else.
2. Have wax base plate of exact form required so that not much scraping is necessary.
3. Keep the rubber clean and do not handle with fingers.
4. Pack the rubber dry.
5. Cut vents at the back of the plate opening into a groove. Do not cut lateral vents.

## VULCANITE.

Vulcanite is a chemical combination of caoutchouc and sulphur.

Caoutchouc is obtained from certain trees growing in South America and the East Indies. Notches are cut into the trees and the milky, sticky fluid is collected. Clay moulds are dipped into this and a thin film allowed to dry on them; the process being repeated until a considerable thickness is obtained, when the mould is broken and shaken out.

It is then dissolved in carbon bisulphide, the solution filtered and the solvent evaporated away, leaving the pure caoutchouc. It is then a grapish white mass, very elastic, insoluble in water, but readily soluble in chloroform and the essential oils. Bisulphide of Carbon.

For dental use it is mixed with sulphur and coloring materials. Sulphide of Mercury is the usual coloring material to which Zinc Oxide is added if a pink color is desired.

The more extraneous matter added the greater will be the density, and the better polish it will take, but its brittleness is greatly increased.

aoutchouc 48
Sulphur 24
[illegible] 96

### BROWN VULCANITE.

| | |
|---|---|
| Caoutchouc | 48 parts. |
| Sulphur | 24 " |

This is the strongest rubber.

### MEDIUM RED.

| | |
|---|---|
| Caoutchouc | 48 parts |
| Sulphur | 24 " |
| Sulphur of Hg. | 36 " |

### PINK.

| | |
|---|---|
| Caoutchouc | 48 " |
| Sulphur | 24 " |
| Vermilion (Hg.S) | 10 " |
| Zinc Oxide | 30 " |

### BLACK.

| | |
|---|---|
| Caoutchouc | 48 " |
| Sulphur | 24 " |
| Drop Black | 24 " |

4

The caoutchouc is softened in a solvent, and the Sulphur and Hg. S rubbed and worked into it to form a homogeneous mass which is pressed into sheets.

## VULCANIZING.

Vulcanizing is a process for hardening vulcanite by the action of heat.

At about 270° a chemical union begins to take place and a sulphite of caoutchouc is produced. The Caoutchouc contains H. O. & C. and part of the H. is displaced by the S. Heating causes a decomposition of the Caoutchouc and the formation of $H_2$ S. If heated too rapidly the $H_2$ S. is evolved too rapidly and causes porous rubber. This is most likely to occur with dark rubbers containing a large percentage of caoutchouc and is scarcely perceptible in pink rubber.

Porosity is prevented and the best results obtained:-

1. By raising the temperature slowly to 300° or 320°. From 30 to 45 minutes should be taken.
2. By applying sufficient pressure.
3, Vulcanizing at a moderately low temperature.

Coolidges regulator &c.

4. By raising the temperature uniformly.
5. By keeping it at the vulcanizing temperature without fluctuation.
6. By keeping it for one hour at 320° or 1-1/4 hours at 315°.
7. By cooling gradually so as to anneal the rubber.

The thermometer does not register the correct temperature of the flask, as the air in the upper part is about 9° cooler. This may be avoided by either:--

1. Blowing off at 212°.
2. Not closing until it has reached 212°.

Vulcanizing at a hign temperature for a short time causes brittle rubber.

Too rapid cooling is unadvisable.:--

1. Because the rubber becomes brittle.
2. The plate may be warped by the greater pressure within the flask than outside.

## VULCANIZERS.

1. Wet steam having one chamber in which the steam is in contact with the water.
2. Dry steam having two chambers so arranged that the steam enters the one containing the flasks by forcing open the valve.

Advantages of dry steam:--

1. Tougher vulcanite.
2. Better color.
3. Denser rubber.
4. Takes a better polish.

Pressure of steam at 320° 85 lbs.
" " " " 324° "
" " " " 328° "

Finishing a plate:--

1. Have the wax plate smooth and of the same thickness as the plate is intended to be.
2. Scrape off the rough surface.
3. Use dry sand paper.
4. " " " " to remove scratches.
5. Smooth with felt cones and finely powdered pumice.
6. Polish with very soft wheels using moist whiting and applying only very light pressure.

## PARTIAL DENTURES.

Partial dentures may be kept in place by:--

1. Clasps.
2. Atmospheric pressure.

Atmospheric pressure is preferable for young patients and clasps for patients past middle age.

In proportion as the remaining teeth are predisposed to caries clasps should not be used.

The advantage of clasping is that the teeth are held more firmly. The disadvantages are:--

1. Greater danger of fracture on account of the unyielding nature of the attachment.
2. In young patients clasps have a tendency to destroy the teeth with which they are in contact.

For clasping, a bicuspid or 1st Molar is best.

1. Use either gold ot gold alloyed with Cu. and Pt. as clasping material.
2. Have the clasp wide so as to cover as much of the tooth as possible.
3. Have it nicely adapted to the tooth.
4. When possible clasp on its mesial and distal surfaces.
5. Make the clasp of a U shape and solder a plate to it transversely, drill holes through the transverse plate for the rubber to pass through and hold it.

A partial denture supported by atmospheric pressure should not lie against the remaining teeth. The edges should be filed down quite thin.

If the edges are thick:--

1. Caries is developed upon the lingual surfaces in contact with the plate.
2. The natural wash between the teeth being prevented caries is developed in their approximal surfaces.

Molars and bicuspids may be replaced by a plate extending across the horizontal portion of the hard palate only.

Anterior teeth may be replaced on a plate which does not touch any other teeth except the adjoining ones to prevent it slipping forward.

Partial dentures of any kind and especially those with clasps should be removed at night, and the mouth thoroughly cleansed. Metal base best.

A metal clasp is preferable to a vulcanite clasp on account of its being capable of readjusting and should be wide.

Clasp on mesial and distal surfaces of natural teeth rather than labial and buccal and lingual surfaces.

Spring plates are made by sawing the cast in two and separating it slightly behind, filling in with plaster and constructing a narrow rim to fit around the teeth.

They are objectionable:--

1. Because they are liable to cause caries.
2. Because they cause as much inconvenience as a larger plate.

REPAIRING. Put the parts together, wax, and make a plaster cast. In replacing a tooth the plate may be put in the mouth and an impression taken.

It is better to cut our a piece of rubber at the fracture and bevel the edges well.

Remove all wax carefully before packing.
Dry the edges carefully.
Smear with a piece of rubber dipped in Chloroform.
Heat the flask before closing.

## VULCANITE BASES.

Advantages:--

1. Perfect adaptation can be obtained.
2. Uniformly solid without cracks or openings.
3. Easily trimmed and fitted.
4. Easily repaired of broken.
5. Very cheap.
6. Impermeably by and insoluble in the fluids of the mouth.
7. Does not wear the teeth as much as metal plates.
8. Light, strong, elastic.
9. Has no galvanic action.

DISADVANTAGES:--

1. Occasionally exerts injurious therapeutical action.
2. Being cheap, patients have had teeth extracted and replaced on a denture which might have been preserved.
3. Produces a heated condition of the mucous membrane.
4. Not so easily kept as a metal plate.
5. Necessary thickness makes them clumsy.
6. Apt to become brittle after wearing a few years.
7. Poor conductor of heat.

## CELLULOID.

The cellolose or fibre of hemp, after the coarser fibres are removed, are converted into paper by the usual process of pulping, spreading and drying. This cellulose has a formula of $C_6 H_{10} O_5$. The paper is then converted into pyroxylin by immersing it in a mixture of,

| | | |
|---|---|---|
| Strong | $H_2 S.O._4$ | 2 parts |
| | $H.N.O._3$ | 3 " |
| | $H_2 O$ | 3 " |

After it has become thoroughly saturated, it is carefully washed and dried. It has become greatly changed, although its appearance remains the same.

1. It has increased 70% in weight.

2. 3 parts of N.O2 have been substituted for 3 parts of H. so that its formula has been changed from C6 H,10 O5 to C6 H7 3 (H.O2)O5.
3. It has become readily soluble in Ether and alcohol (forms Collodion).
4. It has become highly inflammable.
5. Has become explosive.

The Pyroxylin is then reduced to a pulp with a little Sulp. Ether, and the following mixture is made:--

| | | |
|---|---|---|
| Pyroxylin | 100 | parts. |
| Camphor | 40 | " |
| Zinc Oxide | 2 | " |
| Vermilion | 6 to 1 | " |

Alcohol sufficient to dissolve the Camphor.

These materials are ground together, and when thoroughly mixed they are placed in a heated cylinder and subjected to very great hydraulic pressure, the celluloid being squeezed out through a hole in the bottom. The celluloid is then moulded by heat and pressure into "blanks", which are seasoned for about 3 months in a warm room to overcome their tendency to warp, after which they are ready for use.

## ADVANTAGES.

1. Stronger and tougher than vulcanite.
2. Plain teeth can be used and arranged artistically.
3. Contains less vermilion.
4. Approaches the gum color more nearly than rubber.
5. Conducts heat better than rubber and is therefore less injurious to the tissue which it covers.
6. It makes a beautiful temporary denture.

## DISADVANTAGES:--

1. It is difficult to secure as perfect an adaptation as with rubber.
2. Has a tendency to warp.
3. Wears away behind the anterior teeth so that these become loosened.
4. Changes its color and becomes dingy.
5. Becomes porous by evaporation of Camphor; and, by absorbing the oral fluids, becomes very offensive.
6. Although tough it holds the teeth less firmly than rubber.
7. More difficult to manipulate than rubber.

In constructing a denture on a celluloid base an impression is taken; a cast is made; and the teeth adjusted on a base plate the same as for a rubber plate.

In flasking large strong flasks with long accurately fitting guide pins are used. The plaster must not extend upwards on the wax in the lower part of the flask so that all the gum will be in one part. The best and hardest plaster must be used. The cast may be partially made of typemetal as follows:--

Take an impression in plaster. Stick half a dozen tacks in the part representing the ridge, and place a wedge-shaped piece of wood in the centre in front. Fill partly with melted typemetal and when cold pour the plaster as usual.

If the entire cast were made of metal it might be impossible to remove it from the celluloid.

Heat the flask in specially constructed hot air chambers. At 240° the celluloid begins to soften, and pressure should be gently applied by means of the press attached. At 280° it becomes quite plastic, and the flask may then be closed. Care must be taken not to overheat it, as it might take fire--or at least become porous from the evaporation of Camphor.

## SUGGESTIONS:--

1. Be careful not to overheat it. Do not raise the temperature above 300°.
2. Raise the temperature as rapidly as possible.
3. Apply pressure as soon as it becomes plastic, 240° to 200°, and continue until the flask is closed.
4. Cool rapidly.
5. Have tin foil smoothed down over both the surfaces. in the flask, and thus produce a smoother and harder surface.
6. In trimming and polishing keep the plate constantly wet.

## CAST METALLIC BASES.

### Cheoplastic Base,-

Cheoplastic bases are made of pure tin. A cast is made of plaster and sharp sand, about equal parts. The flasks are made so that they will stand upright and have an opening at each upper corner, one being provided with a funnel. Openings are made through the plaster corresponding to these. Into the funnel is poured the metal until it appears at the opposite opening.

## SUGGESTIONS.

1. Have the plaster mould dry and hot.
2. Touch the pins of the teeth with Muriate of Zinc.
3. Have a column in the funnel long enough to give.

desired weight.
4. Pour rapidly.

**WATT'S METAL.** Ag. Sn, Sb

Watt's metal is composed of Tin, Antimony and Silver.

Advantages of these bases:--

1. Being good conductors of heat they can be worn by persons who cannot wear the non-conducting vegetable bases.
2. Weight can be given to lower dentures.

One of the disadvantages is:--

The difficulty of repair. Sometimes they may be repaired by filing the edges investing, covering the edges with Zinc muriate and pouring directly upon the spot through a hole in the plaster.

**ALUMINUM.**

This has advantages as a base:--

1. It is light.
2. Has considerable strength.
3. It is rigid.
4. It is not acted upon by fluids of the mouth.
5. Is a good conductor.

&c., &c.-

**METHOD.**

Heat the mould and melt the metal at the same time in a specially constructed furnace. Then force the metal into the mould by pneumatic pressure from a bulb and rubber tube. Very successful.

No suitable solder for Aluminum. Rubber attachment gets loose.

## SWAGED METAL PLATES.

For metal plates an impression is taken and a model constructed of plaster in the usual manner.

A metallic Die is a facsimile of the mouth in metal and is a copy of the model.

A metallic Counter-die or cast is a copy of the impression and an inverse image of the die.

Essential properties of a die:--

1. Hardness sufficient to resist any force necessary in stamping a plate.
2. Fusibility at a low temperature. This is desirable:-- (a) for convenience; (b) to avoid cooling so far and consequent traction.
3. Non-conduction in cooling as far as possible.
4. Cohesion sufficient to resist blows of the hammer without parting or cracking. (Shrink).
5. Must take a sharp impression of fine lines.

## COUNTER-DIE.

A counter-die should melt at a lower temperature than the die, if more than one kind is used, the first should be somewhat soft and yielding to avoid tearing the plate.

Zinc (773°) and Lead (612°) make a good die and counter-die.

A second die and counter-die may be made of type-metal (about 5000°) for the die, and an alloy of Tin and Lead for the counter-die. Type-metal expands and therefore takes a sharp clean impression.

Type-metal is composed of Lead (5), Tin (2), and Antimony (1); and has many desirable features, but is brittle.

1 Lead and 2 Tin (360°) are harder than lead alone. These therefore are useful in finishing the swaging. Tin melts at 235° C. or 455° F. (?).

Babbit metal is sometimes used as a substitute for type-metal. Copper, lead, & traces of arsenic.

Fusible metal is composed of Bismuth 2 parts, Lead 1 part, and Tin 1 part. It melts at 201° (below boiling point). It may be used for small simple cases. It may be poured directly into the plaster impression, and then when cold if smeared over with smoke the same metal can be poured over it for the counter-die.

## PREPARATION OF DIE AND COUNTER-DIE.

Make a plaster model having it thin so as to get a greater depth of lead. Varnish it with thin shellac.

For moulding a sandybloam such as is used by brass founders is best. Sifted fine grained marble dust is much cleaner. It may be kept moist with glycerine or be moistened as used.

The sand should be moist enough so that it will retain its form if squeezed in the hand and yet be dry enough to fall into powder if struck a slight blow. Before moulding it is desirable to dust a little finely-powdered charcoal over the surface of the model.

In packing do not pack too tightly. If the metal spits on pouring, either- The sand is too wet, or it is packed too tightly.

After packing the sand around the model, turn it upside down and tap it with a light hammer to bring it firmly into contact with the sand. Then cut away a furrow of sand around the cast; tap gently over the surface; hold the cast in place; inverse, and allow it to drop out tapping a little if necessary. If there are undercuts raise one end of the cast so that these edges stand perpendicularly.

In partial sets cut the teeth off the model leaving only enough to show their outline.

In pouring have the lip of the melting pot close to the sand, and pour upon the edge of the mould. When that is full put on the upper ring and fill. When cool take out the sand, inverse and pour the lead. Pour the lead rapidly and have it a little above the melting point.

In pouring lead and tin on type-metal stir it until it begins to get granular; and then pour over the type-metal in a mass. Make several counter-dies and have one ot Tin 2 parts, Lead 1 part.

In swaging bend the gold to approximately fit the cast, leaving enough at the edges to crimp up and be cut off. Anneal frequently. Before annealing be sure that there is no Zn. or Pb. on the gold, as it would burn a hole through it. It can be tested with the tongue which will detect any trace by the metallic taste. If the jaw runs to a sharp point in front, a V. shaped piece may be cut out and the edges soldered together with a solder just below the metal. If it contains an air-chamber go around it with a punch and light blows before the final swaging.

The plate having been swaged grind the teeth to fit the plate and thus avoid spaces where food can accumulate and become offensive. Accutate adaptation may be obtained by smearing the plate with oil and rouge; and grinding the teeth whenever they touch.

Attach the teeth with wax. If gum teeth are used in order to close the space behind them and protect the edges, a band should be placed over the upper edge.

This is done by placing the plate face downward in plaster and burnishing a thin plate of gold over the edge of the gum and along the edge of the plate.

The teeth are then removed and this band trimmed and soldered fast. It is then returned to the plaster and the teeth adjusted again.

The plate is then invested in a batter of 1/2 (or more) sand, and 1/2 plaster. The plaster should be 1/4 inch thick over the teeth.

Remove the teeth and back them so that the backing will fit the plate. Countersink the pin holes and rivet. Cover the pins with a triangular piece.

Before soldering clean all the surfaces by scraping.

Apply the borax with a camel's hair pencil in the form of a paste with water. Borax from which the water has been driven off by heating is the best.

Cut the solder up into square pieces and put it all on before heating. Heat over a Bunsen flame or in a coal stove. If in a stove remove to a piece of charcoal when the whole mass is red hot.

In soldering if the solder balls up, drop a little powdered borax on it.

If you wish to draw it to a certain point heat that point more than the solder. Have gravitation assist you as much as possible. Solder always goes to the hottest place.

Lay a piece of charcoal over it and allow it to cool gradually till quite cold.

## VULCANITE ATTACHMENTS.

Teeth are often attached to metal plates by means of vulcanite. The great advantage of that mode of attachment is the cleanliness, as there are no places where particles of food can lodge. One disadvantage is that in case of injury to the metal all the teeth must be removed in order to repair it.

There are two methods of attaching by vulcanite:--

1. Where the gold extends over the ridge.
2. Where the gold does not cover the ridge.

In the first variety the edge of the gold is strengthened and completed with a band to protect the edge of the rubber. A thin rim is also soldered internally to protect the rubber at that point. To attach the rubber a platinum wire is bent into loops and soldered fast to the gold around the alveolus behind the teeth.

A disadvantage to this variety is that the edge of the plate cannot be trimmed without marring it.

In the second method the plaster cast is built up with wax over the alveolus, and a cast made and the plate swaged up. This leaves a space to be filled in with rubber.

Strengthen the free edge by a half round wire or double thickness of gold. Punch a few holes through the gold and countersink them. Finish wax at the internal angle of the front horizontal portion. The vulcanite will pass below and above the plate and make it very strong.

## CLASPS.

In making a partial denture retained by clasps have three casts, one being made of plaster and sharp sand.

Cut out the plate after it is swaged so that there is just room between the plate and the tooth to be clasped for the clasp to stand up. Use a clasp made of gold alloyed with Cu. or Pt. and bend it to fit the tooth accurately. Try in the mouth before attaching the teeth.

Do the soldering of the clasps upon the plaster and sand model.

The clasps should cover the whole length of the crown.

## CROWNING.

There are several things necessary:--

1. The root must be healthy.
2. The crown must fit the end of the root accurately.
3. The crown must be accurately and securely cemented in position.
4. The joint must be made below the margin of the gum as the cement will not dissolve out so readily in that position.

## LOGAN CROWNS.

As Logans are not made in very great variety one can be made from an ordinary pivot tooth very readily. Cement a platinum pin in place and hold the pin immediately in the flame of an alcohol lamp.

Drill the hole of an oral form and thus avoid weakening the lateral walls and subsequent splitting.

To adapt the crown perfectly to the root cover the end of the crown with a thin sheet of wax and press to place.

There are several modifications of the Logan. The Logan proper is concave at the base at the base around the pin and is intended to be ground off to fit the end of the root. . The Pamely Brown is convex at the base and the root is ground off to fit the tooth.

A vulcanite pivot tooth may be made by trimming the end of the root, fitting a pin in place, taking an impression and replacing the pin in the impression; then making a plaster cast and adapting an ordinary rubber tooth. The tooth is then backed up with wax; notches are filled in the end of the pin, and the whole vulcanized together with red and black rubber.

Still another method is to fit the pin to the root, burnish thin platinum over the end of the root with the pin projecting, taking an impression and making a cast. Then backing the teeth with the platinum and soldering all together with gold.

OBJECTIONS TO THESE FORMS:-

1. Danger of splitting the root.
2. The cement dissolves out leaving the end of the root subject to caries.

The first objection is partly overcome by making the crown of a concave or triangular form at its base.

CEMENTING:

1. In cementing have undercuts in the labial and lingual walls of the root canal.
2. Have the pin barbed.
3. If Gutta Percha is used, warm the pin and the Gutta Percha, and mould it around the pin until a little larger than the space to be filled, and projecting beyond the point of the pin. Heat until quite plastic and force to place. Trim with a heated knife, or chloroform on cotton.

Gutta Percha is preferable to Cement:-

1. It is insoluble in the fluids of the mouth.
2. Can be more easily removed. It should be a soft variety.

## RICHMOND CROWNS.

1. Prepare the root as far as an ordinary pivot tooth.
2. Bevel the sides of the end of the root so as to form parallel walls.
3. Bend a band to fit the end of the root; bend the edges so as to overlap, and solder together.
4. File this band so as to be of equal width throughout and yet conform to the contour of the gum.
5. Place in position and place a pin in the root about 3/8 of an inch long and projecting slightly.
6. Take an impression of the parts and replace the band and pin in the impression.
7. Take a cast of plaster and sand.
8. Take a thin piece of platinum or gold; flow solder over it; perforate it with a pin; adapt it to the band and solder it by holding it over a flame; trim so as to form a cap.
9. Fit a plate tooth to the space; back it with platinum; bend the pins down over the platinum.
10. Adjust this over the model; soak the model in water, and secure the tooth by investing it in more plaster and sand, so as as to leave only the backing exposed.
11. Solder with coin gold or a solder (Richmond's) composed of:

| | |
|---|---|
| Coin Gold | 5 parts, and |
| Fine Brass Wire, | 1 part. |

12. Trim; polish.
13. Cement in place with Gutta Percha or Cement.

## RICHMOND GOLD CROWNS.

If the tooth remains trim it so that its walls are parallel. If only the root remains place a pin in it and build up around with amalgam. Have a head on the pin.

Take the size of the root or tooth with thin copper having it of such a length that the opposite teeth will just occlude with it. Have it higher externally and internally to represent the cusps.

Make a gold band of the same form, and solder the edges together by bevelling them. Then try in the mouth and trim if necessary. Invest the band with plaster and sand, and when hard trim it out inside the band, so as to leave a convex surface. To this, fit a rather heavy piece of platinum, and fill in with gold solder. Build up the cusps if necessary by laying pieces of gold upon them and attaching them by heating the solder. Trim to the shape of a natural tooth.

In the case of a molar the 4 corners are left high; solder filled in, and built up with pieces of gold.

A gold crown for a bicuspid with a porcelain face may be constructed by first attaching a pin firmly to the root with amalgam and then making a gold band,-preferably lined with platinum,-to fit it, and of the desired length. The buccal surface is then cut out and a porcelain tooth is backed and fitted to the space, and finally soldered in place. The band is now cemented in place, and the band filled in around the pin with amalgam. The exact occlusion is obtained by biting into the amalgam while soft.

BONWELL CROWNS.

In this variety the pin is cemented in the root, and the end of the root covered with amalgam. While still soft the crown is pressed upon it so that an accurate adaptation is obtained. The crown has an opening through it, and when the amalgam is hard the space around the pin in the opening is filled with cement. The tooth is weak, however, and the amalgam turns black at the cervical edge.

HOWE CROWNS.

These have 4 long pins. The pin is cemented in the root; the tooth pins bend over it; the palatal face built up with amalgam.

CONTINUOUS GUM WORK.

This is beautiful and clean, but very liable to fracture.

PROCESS:- Make a cast and die and swage up a platinum plate. Trim up the edge to form a smooth round trim and stiffen the edge behind by soldering a thin strip along it with pure gold. The teeth are then set up. Each should touch the plate at some point and the long pin is soldered fast to the plate also with pure gold.

The body is then applied, care being taken to fill all the spaces. After it is trimmed to shape, plaster and quartz are poured into the platinum to form a cast, and the whole placed in a muffle and gradually heated. When removed it is covered with cracks which are filled up and the process repeated. The gum enamel is then painted on and the whole is placed in the muffle and heated until vitrified. May be used for partial sets using palin teeth , attaching them to platinum and afterwards attaching to a rubber plate.

Advantages:- 1.Very clean.
Disadvantages1.Considerable difficulty in adaptation.
2.Heavy.
3.Difficulty of repair; i.e. expensive.
Continuous gum work is not adapted to lower dentures.

## REGULATION.

Causes of irregularity:--

1. Admixture of races.
2. Heredity.
3. Premature extraction of temporary teeth.
4. Delayed extraction of temporary teeth.
5. Extraction of permanent teeth at an early age.
6. Habit of sucking when young.

Do not extract for regulation as a rule until the teeth are fully developed.

If the irregularity is caused by premature extraction it will usually be necessary to extract a tooth and make room.

Do not extract the cuspid if it can be avoided.

When the choice is between the lateral and bicuspid as it usually is, to save the later if possible.

Where the incisors erupt entirely within the temporary ones so that the latter do not come loose they should be extracted.

When the arch is filled before the eruption of the cuspid and this eruption outside the arch the bicuspid may be extracted at once to make room for it.

To correct erupting teeth which have a tendency to bite inside the lower an inclined plane may be used. A plate is made to fit over the anterior teeth with an inclined plane projecting upwards against which the upper tooth bites throwing it outwards.

Teeth may be forced outwards by Jack-screws attached to a plate. The plate should be ligatured to the teeth and a half turn should be given about once an hour.

Ligatures of Elastic rubber may be used to draw teeth into place. They may be kept from slipping under the gum by inserting a gold screw into the tooth.

After regulating, unless the occlusion keeps the teeth in place, a stay plate or other device must be worn for 6 months or a year.

## CLEFT PALATE.

Cleft palate may be congenital or accidental. It may be treated by a surgical operation known as Staphyloraphy or by means of a mechanical appliance. The surgical operation is indicated only in very young children. If there is only a simple perforation of the hard palate a button may be fitted over it. If the soft palate is perforated it is best to attach the button to a plate by a hinge to prevent its becoming dislodged.

If the soft ~~xkx~~ palate is completely split apart either an artificial vellum or an obturator may be constructed.

An obturator is a fixed and rigid appliance against which the muscles close.

A velum is a movable appliance which is utilized by the remnants of the muscle.

A velum is made with a plate covering the hard palate to which is hung a plate of rubber in front of the soft palate. A plate of rubber is made to cover the posterior wall of the soft palate being attached to the anterior one by a neck passing through the opeining.

## OBTURATOR FOR ACCIDENTAL CAUSES.

With an impression cup lengthened out behind take an impression of as much as the irritability of the parts will allow. If the parts are very sensitive paint them with a strong solution of Bromide of Potash.

Make the oval part of the plate with a projection extending backwards and vulcanize slightly. Build on this projection with impression compound. Then dip in boiling water to soften it and after inserting direct the patient to swallow. Trim and repeat the process until an accurate impression is obtained. Test it by having the patient hiss to insure closure, and then by closing the lips and breathing through the nose to make sure that it is not too large.

At the posterior edge it should be 1/2 inch deep to insure closure at some point. It must slope downwards so that the mucous will slide down and off of it Construct it of black rubber and vulcanize slowly.

## SOLDER.

Richmond alloys his silver with brass. American gold coin is 900-1000 = 21 6/10 K; 100-1000 is Cu. & Ag.

English gold coin is 916 6/10 - 1000 = 22 K.

For an 18 K.solder 120 grs. American Coin gold -24 grs. of fine brass wire. Avoid burning the solder as you will burn the gold out and raise the melting point and it will not flow easily.

First melt the au. and then add the brass.

American C. Au. 120 grs.- 31 grs.brass - 17 K. solder.
" " " 120 " - 42 " - 16 K.
" " " 120 - 53 " - 15 K. "
" " " 120 " - 24 " " - 18 K.

An 18 K. gold plate reg. a 15 K. solder
Jeweler's solder is 8 K. or 10 K. as they wear better.

## FLAGG'S SUBMARINE AMALGAM.

Sn. 35. Ag.60. Cu.5. -100.

Put Ag. & Cu. in crucible and heat until cherry red; then put in Sn. Have ingot long and narrow. For filing use No. 11 file. Then file all up. Clear from Fr. filings by using magnet over filings spread out on paper (100 times) or until no more stick to magnet. Then sift through a sieve 40-60 meshes per inch. Boil a dipper of water, and hold the sifted filings over the steam in another dish without wetting it "to age it." Bottle for use. (Watson D. D. S.).

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